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INSTRUCTION MANUAL

MODEL

TTS 2761 AND TTS 2761R
MF SIGNALING DISPLAY

NORTHEAST ELECTRONICS CORPORATION
P.O. BOX 649 - CONCORD, N. H. 03301
AREA CODE 603 224-7466

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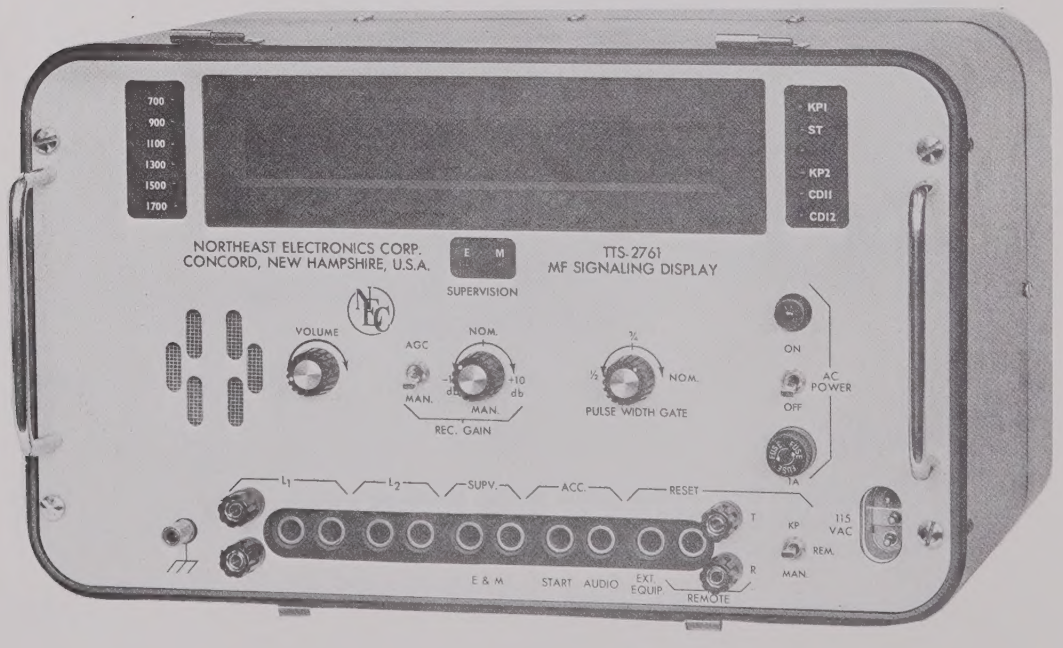


Figure 1-1. Model TTS 2761 MF Signaling Display

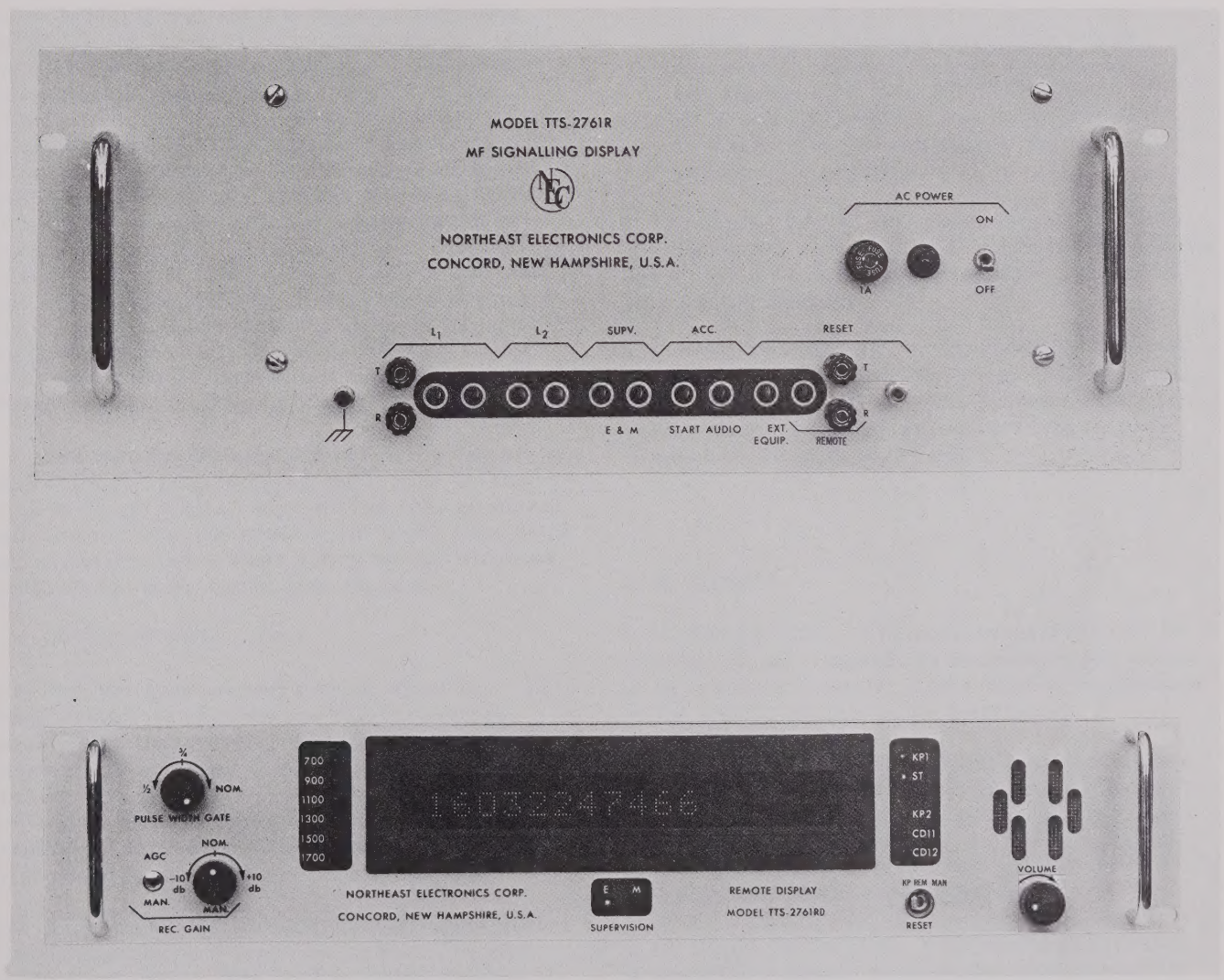


Figure 1-2. Model TTS 2761R Main and Remote Display Units

SECTION 1

DESCRIPTION

1.1 INTRODUCTION.

1.2 The Northeast Electronics Corporation Model TTS 2761 (Figure 1-1) is a portable, solid state, bridging test set that displays MF codes, MF digits and dc supervision appearing on standard 4 or 6 wire telephone circuits. The relay rack mounted version of the TTS 2761 is the TTS 2761R (Figure 1-1). The portable and rack mounted versions are electrically and functionally identical and, except for the obvious mechanical differences that permit the rack mounting of the TTS 2761R, the only difference between the two sets is that the TTS 2761R consists of two subunits connected by a fifteen foot cable. One subunit contains the majority of the control circuitry and the access jacks while the other contains the display circuitry and indicators. Except where noted this manual pertains to the portable and rack mounted versions of the test set.

1.3 The test set features individual display of each valid MF tone received, collective display of up to 16 MF digits, automatic or manual signal gain control, a small speaker for audio monitoring and adjustable pulse width gating to help diagnose marginal or faulty signal transmission.

1.4 INPUT CONNECTIONS.

1.5 Two bridging through circuit inputs (L1 & L2) are provided via two dual (parallel connected) jacks on the front panel. The rack mounted version also provides these connections on a barrier strip at the rear of the main unit. To avoid confusion, only the signals appearing on L1 are displayed. However, audio from both L1 and L2 is provided by the audio monitoring speaker.

1.6 High impedance through circuit connections are provided by dual (parallel connected) jacks on the front panel. The rack mounted version also provides these connections on a barrier strip at the rear of the main unit. The E lead corresponds to the tip and the M lead to the ring.

1.7 The display may be reset by a momentary dry contact closure between the tip and ring of the REMOTE RESET jack on the front panel. The rack mounted version also provides these connections on a barrier strip at the rear of the unit.

1.8 THE DISPLAY.

1.9 NUMERIC. Up to 16 MF digits may be displayed simultaneously and held until a reset command is given. The BURROUGHS SELF SCAN® panel display provides an easy to read single plane dot matrix display, with characters approximately 0.4 inches high and 0.28 inches wide.

CODE. High intensity solid state lamps are used to indicate the reception of the MF signals KP1, KP2, ST/ST2P, CD11/ ST3P and CD12/STP. The lamps remain lit after signal reception until the reset command is received.

1.10 SUPERVISION. Solid state lamps are used to indicate the status of the E and M leads. Lamps are lit for a reset (on hook) condition, are off for an off hook condition.

1.11 INDIVIDUAL MF FREQUENCIES. Individual solid state lamps indicate which MF frequencies are being received. The proper lamp is lit during the time that its associated frequency is present at the input to the set.

1.12 RESET.

1.13 SELECTION. The reset cycle for the entire display may be triggered by successive KP pulses or by a switch closure. The source is determined by the RESET switch on the front panel.

1.14 KP RESET. In this mode, a dialed number and codes are displayed until the next KP pulse is received. This automatically clears the unit so that the current number and codes, including KP1 or KP2, may be displayed. Either KP1 or KP2 will initiate the reset cycle.

1.15 REMOTE RESET. With the RESET switch in the REM (remote) position the display may be completely reset by a dry contact closure between tip and ring (chassis ground) of the REMOTE RESET jack on the front panel or the corresponding barrier strip connections at the rear of the main unit. The input is compatiable with TTL 5 volt logic, and represents two unit loads. The Remote Reset signal must exceed 10 msec in length, but may remain low (closed) until 10 msec before the next reset signal. Contact bounce on closure or break will not cause false reset.

1.16 MANUAL RESET. The display may also be reset by moving the RESET switch to the momentary MAN (manual) position.

1.17 DIAGNOSTIC AIDS.

1.18 MANUAL GAIN CONTROL. With the AGC/MAN switch in the MAN position, the operator can adjust the MF signal amplification of the unit by approximately ±10 dB from a nominal level (The nominal level is factory adjusted to accept MF pulses at -10 dBm minimum). By adjusting the gain and observing the individual frequency displays, the operator can identify frequencies that are arriving substantially above or below this norm.

1.19 PULSE WIDTH GATE CONTROL. Using this control, the operator can vary the minimum MF pulse length accepted and displayed by the unit from approximately 35 msec to approximately 18 msec. Thus short MF pulses will be displayed only after the gate width is reduced.

1.20 AUXILIARY FUNCTIONS.

1.21 ACCESSORY START. A relay contact closure is provided between the tip and ring of the ACC START jack on the front panel when either the E or M supervision indicates an off hook. This condition lasts until both have returned to on hook. The contacts are suitable for switching 115 volts ac at currents up to 2 amps. The rack version also provides these connections on a barrier strip at the rear of the main unit.

1.22 ACCESSORY AUDIO. The combined and partially equalized audio from L1 and L2 is fed to the tip and ring of the ACC AUDIO jack on the front panel. The level is approximately 1 kΩ, with the ring at chassis ground. The rack mounted version also provides these connections on a barrier strip at the rear of the main unit.

1.23 AUDIO MONITORING. A small speaker and volume control is provided. Its output is the combined and partially equalized audio from L1 and L2.

1.24 AUX. OUTPUT. Logic level outputs in parallel with the data and lamp display lines are brought out to an auxiliary connector. MF digit data is in BCD format. These outputs are TTL compatiable (Fan out $\geq$2) and are intended for use with auxiliary equipment such as printers, computers etc.

SECTION 2
SPECIFICATIONS

2.1 INTRODUCTION.

2.2 Table 2-1 lists the specifications of the Models TTS 2761 and TTS 2761R.

TABLE 2-1 Specifications

CONDITIONS:
$T_A = 25 \pm 10°$

V ac = 115± 10V rms

Impedance - measured 600 Hz to 2 kHz unless otherwise stated.

MF RECEIVERS (L1).

a. Input Impedance:	≥20 kΩ balanced, dc blocked.
b. Input Isolation:	1MΩ to ground
c. Minimum Sensitivity (Combined pair).	
1. AGC	-25 dBm
2. MAN	-3 dBm to -2[illegible] dBm (adjustable)
d. Dynamic Range:	
1. AGC	32 dB min.
2. MAN	6 dB min.
e. Maximum Twist:	6 dB
f. Tone Filter Band Widths:	
1. AGC	3% to 5% of center frequency.
2. MAN	Depends upon signal level and gain setting.
g. Minimum Pulse Width:	Approximately 18 to 35 msec (adjustable)
h. Minimum Reset Time between pulses:	10 msec

NUMERIC DISPLAY.

a. Type:	Single plane neon dot matrix.
b. Capacity:	16 digits
c. Character Size:	0.4"h x 0.28"w
d. Function:	Display MF digits 0-9 received after KP or Reset and before ST.
e. Display Time:	Reception to reset

MF CODE DISPLAY

a. Type:	Individual LED's with caption.
b. Codes:	KP1, KP2/ST2P, ST, CD11/ST3P, CD12/STP
c. Display Time:	Reception until reset

MF FREQUENCY DISPLAY

a. Type:	Individual LED's with caption.
b. Frequency:	700, 900, 1100, 1300, 1500, 1700 Hz
c. Display Time:	During reception only

RESET

a. KP Reset:	Display automatically resets during each KP1 or KP2 pulse. Ext. Equip. Reset Relay does not operate.
b. Remote Reset:	Display resets, Ext. Equip. Reset Relay operates. Unit will display without KP1 or KP2/ST2P
1. Reset Command:	Switch closure T to R (≤100 Ω) or TTL/DTL/RTL logic "0" (R= ground).
2. Command Sequence:	Open (logic "1") for ≥10 msec prior to closure (logic "0"). Closure (logic "0") for ≥20 msec.

TABLE 2-1 Specifications (cont)

3. Command Current: Logic "1":	$I_1 \leq 0.1$ mA (sink or source)
Closure or Logic "0":	$I_0 \leq 3.2$ mA (sink)
4. Ext. Equip. Reset Contact Rating:	10 watts resistive 50 V or 0.5 A maximum.
c. Manual Reset	Display resets, Ext. Equip. Reset Relay operates. Unit will operate without KP1, KP2/ST2P.
SUPERVISION:	
a. Display	
1. E lamp on:	$V_{Tip} \leq -12$ V or open.
off:	$V_{Tip} \geq -5$ V
2. M lamp on:	$V_{Ring} \geq -5$ V
off:	$V_{Ring} \leq -12$ V or open.
b. Input Current	
1. $V_{in} = 0$ V:	$I_{in} \leq 1.5$ mA (source)
2. $V_{in} = -48$ V:	$I_{in} \leq 0.1$ mA (sink)
AUDIO (L1, L2)	
a. Input Impedance:	≥ 20 kΩ balanced, dc blocked.
b. Input Level:	-26 dBm to -10 dBm per line.
c. Output:	L1 and L2 audio added.
ACCESSORY AUDIO OUTPUT (L1, L2)	
a. Output Impedance:	1 kΩ±10%
b. Output Level (1 kHz):	Approximately 0 dBm (O. C.) at -18 dBm input (1 line).
ACCESSORY START	
Contacts closed:	E or M = off hook
Contacts open:	E and M = on hook
Contact Rating:	115 V, 2 A rms max.
POWER CONSUMPTION:	< 60W
MECHANICAL.	
MAIN UNIT	
a. Outside Dimensions:	19.0"w x 6.97"h x 9.91"d For rack version. 8.25"w x 14.0"h x 14.25"d for portable version.
b. Handles:	1.375" beyond front panel
c. Mounting:	Standard 19" rack spacing
d. Weight:	(Rack) Approx. 18 lb. (Portable) Approx. 23 lb.
DISPLAY UNIT. (Rack mounted only).	
a. Outside Dimensions:	19.0"w x 3.5"h x 3.16"d
b. Handles:	1.22" beyond front panel
c. Mounting:	Standard 19" rack spacing
d. Weight:	Approximately 4 lb.
ENVIRONMENTAL.	
OPERATING	
a. Ambient Temp:	25±10°C
b. Relative Humidity: (no condensation at 50° C)	0 to 85%
STORAGE	
a. Ambient Temp:	0 to 70° C
b. Relative Humidity: (no condensation at 50° C).	0 to 85%

SECTION 3

OPERATING INSTRUCTIONS

3.1 VISUAL INSPECTION. Examine the TTS 2761 for obvious damage in shipment. Check the housing of the numeric display for cracks.

3.2 INSTALLATION. The TTS 2761R may be mounted in a standard 19 inch rack. Both the main unit and the display unit should be located where the controls are accessible. The allowable distance between the two units is limited by the length of the interconnection cable. (A fifteen foot cable is normally supplied with each set). Both units should be handled with care at all times. Severe shock may damage the numeric display.

3.3 A single cable connects the display and main units. To install, plug one end of the cable into the lower receptacle (J2) at the right rear of the unit. Tighten locking screw until plug and receptacle are fully mated. Insert the other end of the cable into the receptacle on the rear of the display unit and tighten locking screw until plug and receptacle are fully mated.

3.4 AC POWER. With the main unit dust cover in place, connect the AC power cord supplied with the set to the recessed AC power plug at the rear of the main unit. Connect the other end to a 115 volt 60 Hz source.

3.5 ELECTRICAL INSPECTION. With no additional connections to the set, turn the power switch (Main unit) on. Correct indications are:

a. AC power lamp (Main unit) on.

b. Frequency indicators (Display unit) on briefly then off.

c. SUPERVISION E lamp (Display unit) on.

d. SUPERVISION M lamp (Display unit) on.

e. MF Code lamps (Display unit) on or off.

f. Numeric display (Display unit) blank or displaying random digits.

3.6 Move the RESET switch on the Remote Display unit to the MAN position momentarily. All lamps except the SUPERVISION E and M lamp should go off. The numeric display should go blank.

NOTE

Rapid on/off cycling of the power switch may cause one or more of the frequency detectors to "latch up" (frequency lamps on). Such rapid cycling should be avoided. If latch up occurs, turn power off, wait approximately five seconds and turn power on again.

3.7 OPERATIONAL CHECK.

3.8 MF and AUDIO CHECK .

a. Connect the output of an NEC TTS 59A Portable MF Sender, or equivalent to either of the L1 jacks (or to the binding posts) on the front panel of the main unit. Set the following switch positions:

Control	Location	Position
OUTPUT	TTS 59A (B)	-6 dBm
RESET	TTS 2761R Display Unit TTS 2761 Front Panel	KP
AGC/MAN	TTS 2761R Display Unit TTS 2761 Front Panel	AGC
VOLUME	TTS 2761R Display Unit TTS 2761 Front Panel	Midrange

b. Send KP1, 0 1 2 3 4 5 6 7 8 9, ST from the TTS 59A (B). The Frequency lamps should light in pairs as the signals are keyed. The speaker should reproduce audible tones. The KP1 and ST lamps should remain on, and the digits should be displayed in sequence on the numeric display.

c. Send KP1 again. The display should go blank, the ST lamp should go out, but the KP1 lamp should stay on.

d. Send ST, followed by any random digits. The ST lamp should light, but the digits should NOT be displayed.

e. Repeat step b with the TTS 59A (B) OUTPUT at +1 dBm and then at -22 dBm. The results should be the same.

f. With the TTS 59A OUTPUT at -22 dBm, send a steady KP1. Throw the AGC/MAN switch to the MAN position and turn the MAN gain control full CCW. The frequency

lamps should be out or just flickering. Turn the MAN gain control slowly to full CW. The 1100 Hz and 1700 Hz lamps should be on.

NOTE

The unit requires time to stabilize after each adjustment of the MAN gain control. Gradual adjustment of the control is desirable.

g. Continue to send a steady KP1 at -22 dBm. Rotate the volume control through its full range. The speaker output should vary from inaudible (full CCW) to clearly audible (full CW).

h. Connect the TTS 59A to L2 of the TTS 2761R, and send a steady KP1. The audio volume should be approximately the same level as it was on L1.

i. Plug a 310 patch cord into the ACC AUDIO jack and connect an AC voltmeter suitable for audio frequency measurements (Triplett 630 or a Simpson 260) between tip and ring of the other end of the cord. Send KP1 at -6 dBm. The voltmeter should read between 0.5 V rms (approximately -3.8 dBm) and 1.0 V rms (approximately +2.2 dBm).

j. Disconnect the TTS 59A and remove the patch cord from the ACC AUDIO jack.

3.9 SUPERVISION. Plug a 310 patch cord into one of the SUPV jacks on the front panel of the main unit, with the TIP of the supervision jack grounded, the E lamp should go off. With the ring of the supervision jack to -48V, the M lamp should go off.

3.10 ACCESSORY START RELAY (optional check) Plug a 310 patch cord into the ACC START jack and connect an ohmmeter between tip and ring. Check the following combinations:

SUPV. JACK TIP	RING	OHMMETER INDICATION
OPEN	OPEN	OPEN
GND	OPEN	SHORT
OPEN	-48V	SHORT
GND	-48V	SHORT

3.11 EXTERNAL EQUIPMENT RESET (Optional check)

a. Move the 310 patch cord from the ACC START jack to the EXT EQUIP RESET jack, leaving the ohmmeter connected between tip and ring. The ohmmeter should indicate an open circuit.

b. Move the RESET switch on the display unit to the MAN position. The ohmmeter should indicate a short circuit.

c. Plug a 310 patch cord into the REMOTE RESET jack on the front panel of the main unit. Short tip to ring at the other end. The ohmmeter should indicate a short circuit. This completes the checkout. Remove all patch cords.

3.12 CONTROL SETTINGS FOR NORMAL OPERATION.

a. MAIN UNIT	
AC POWER	- ON
b. DISPLAY UNIT	
RESET switch	- KP
PULSE WIDTH GATE	- full CW
AGC/MAN switch	- AGC
MAN gain	- Mid-range
VOLUME	- Mid-range

3.13 OPERATION IN A 4-WIRE PATCH BAY.

a. Supervision. The TTS 2761 will function normally without supervision, except that:

1. The E and M lamp will stay on.

2. The Accessory Start contacts will remain closed.

b. Using Monitor Jacks. Connect the TTS 2761 as indicated in Table 3-1.

c. Using Line and Drop Jacks. Connect the TTS 2761 as indicated in Table 3-2.

NOTE

To avoid interruption of an operating circuit, plug cords into the TTS 2761 first, then into the patch bay. The through circuit in the TTS 2761 will maintain the continuity of the signal path.

Table 3-1 4 Wire Patch Bay Connections using Monitor Jacks

Desired Display	Desired Audio	Single 310 Patch Cord Connections L1	L2
TRANS		TRANS MON JACK	
TRANS	TRANS & REC	TRANS MON JACK	REC MON JACK
REC	REC	REC MON JACK	
REC	TRANS & REC	REC MON JACK	TRANS MON JACK

Table 3-2 4 Wire Patch Bay Connections using Line and Drop Jacks

Desired Display	Desired Audio	Double 310 (241) Patch Cord Connections L1	L2
TRANS	TRANS	TRANS LINE & DROP	
TRANS	TRANS & REC	TRANS LINE & DROP	REC LINE & DROP
REC	REC	REC LINE & DROP	
REC	TRANS & REC	REC LINE & DROP	TRANS LINE & DROP

Table 3-3 6 Wire Patch Bay Connections

Desired Display	Desired Audio	Dual 310 (241) Patch Cord Connections L1	L2
TRANS	TRANS	TRANS LINE & DROP	
TRANS	TRANS & REC	TRANS LINE & DROP	REC LINE & DROP
REC	REC	REC LINE & DROP	
REC	TRANS & REC	REC LINE & DROP	TRANS LINE & DROP

3.14 OPERATION IN A 6 WIRE PATCH BAY.

a. Supervision. Supervision may be monitored if desired, but is not necessary for normal operation of the TTS 2761 (See paragraph 3.13 a). If supervision is monitored:

1. The E and M lamps will indicate the status of the line, and

2. The Accessory Start contacts will be closed when either end is off hook, and open when both ends are on hook.

b. To monitor supervision, plug a dual 310 (241) patch cord into the SUPV jacks on the front panel of the TTS 2761 main unit, then plug the other end into the "signaling" jacks in the test bay. The through circuit in the TTS 2761 will maintain a continuous supervisory path.

c. Line and Drop Connections. Connect the TTS 2761 as indicated in Table 3-3.

NOTE

To avoid interruption of an operating

circuit, plug cords into the TTS 2761 first, then into the patch bay. The through circuits in the TTS 2761 will maintain the continuity of the signal path.

3.15 HARD WIRED OPERATION. An 18 position barrier strip is provided inside the rear of the main unit for hard wire connections. All front panel connections are duplicated at the rear. Barrier strip signal locations are identified on the Installation Drawings. As described in the previous sections, a connection to L1 provides display and audio. A connection to L2 provides only audio.

3.16 REMOTE RESET OPERATION. With the RESET switch (front panel, display unit) in the REM position, the display will reset only when triggered by a remote reset command (See paragraphs 1.3c, 1.5c, 2.7). Other connections remain unchanged in this mode of operation.

3.17 DIAGNOSTIC OPERATION.

a. The TTS 2761 can be helpful in trouble-shooting marginal or inoperative MF Systems. The line under observation is assumed to be out of service so that known MF sequences may be sent at machine or manual rates.

b. Detecting Short MF Pulses (Machine send).

1. If MF signaling errors are noted on machine pulsed numbers, but not on manual pulsed numbers from the same MF supply oscillators, short pulses may be the cause. The TTS 2761 can be used to determine if short pulses are being sent or received. However, since channel distortion is possible, a valid send signal in office A does not guarantee a valid receive signal at office B. Both ends of the circuit should be checked.

2. With the TTS 2761 connected to one end of the line in question as described in Sections 3.12 to 3.16, send a known sequence of MF signals - preferably including all digits - from the suspect sender. If the display is correct, the MF pulse widths are proper AT THE POINT MONITORED. If the display is in error, rotate the Pulse Width Gate Control full CCW and send the sequence again. If the display is correct or greatly improved, MF pulses are too short at the point monitored.

3. The procedure can be repeated at intermediate settings of the Pulse Width Gate Control to determine approximately how long the pulses actually are.

c. Detecting Excessive Twist, Low Signal Level.

1. If particular MF signals, or groups of signals using a common frequency fail to register correctly even on slow manual send, one or more of the MF frequencies may be significantly lower than the others in amplitude.

2. If registration is generally erratic even on slow manual send, the signals may all be too low in amplitude.

3. Both conditions can usually be detected using the TTS 2761 .

4. Connect the TTS 2761 to the circuit in question as described in Sections 3.12 to 3.16. Very slowly, send a known sequence of MF signals - preferably including all digits. Check the frequency lamps during send to see if the proper lamps light in pairs.

5. If the display is not correct, go back to the signal (or one of the signals) that produced an error and send it steadily. Check the frequency lamps to determine which tone is not being received (or is being received but should not be). Throw the MAN/AGC switch to MAN, and slowly adjust the MAN gain control.

6. If the display is corrected by turning the control CW (increasing gain) the level of the wayward tone is low, but roughly within the absolute system limits (-23 dBm). If the display is corrected by turning the control CCW (reducing the gain) the level of one or more of the tones being sent is apparently too high, generating harmonics in the receivers.

7. The procedure may be repeated for other MF signals that do not produce a correct display. A tally of the results

will indicate which tones are low in level at the point tested, and which tones or pairs of tones are too high.

NOTE

The lower signal level threshold of the set is more sensitive than the upper threshold. For example, with the MAN Gain control in the Nom. (-10 dBm) position, a tone at -13 dBm would probably not be accepted, whereas a tone at -7 dBm would.

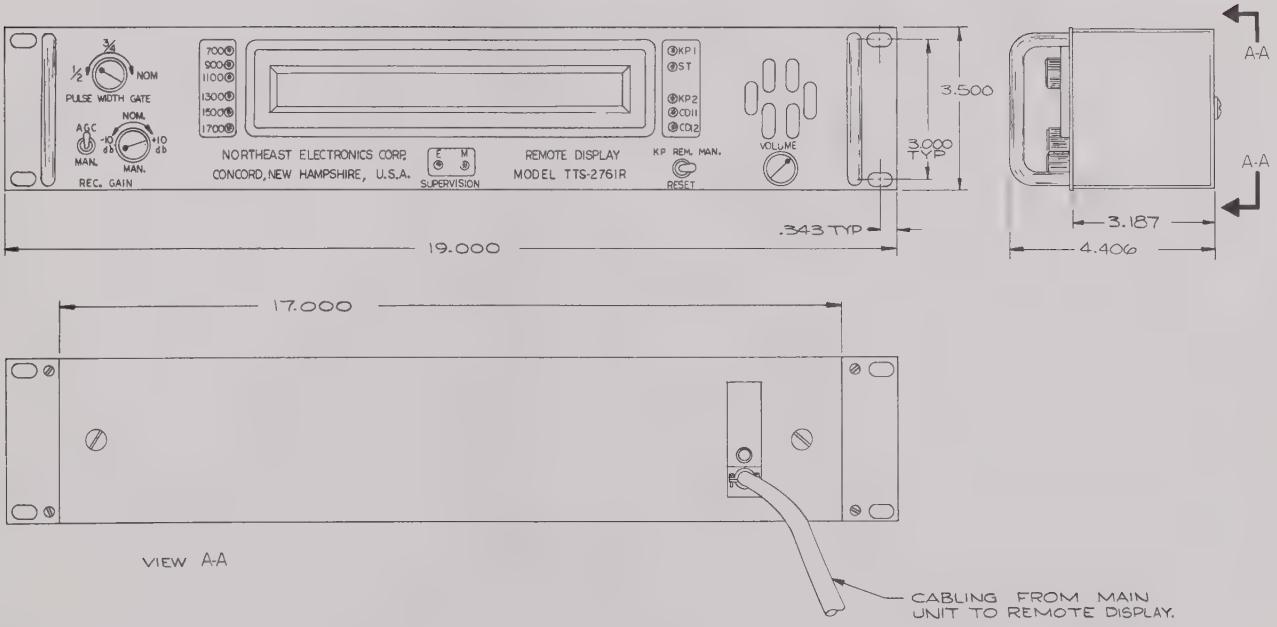


Figure 3-1. Installation Diagram Remote Display

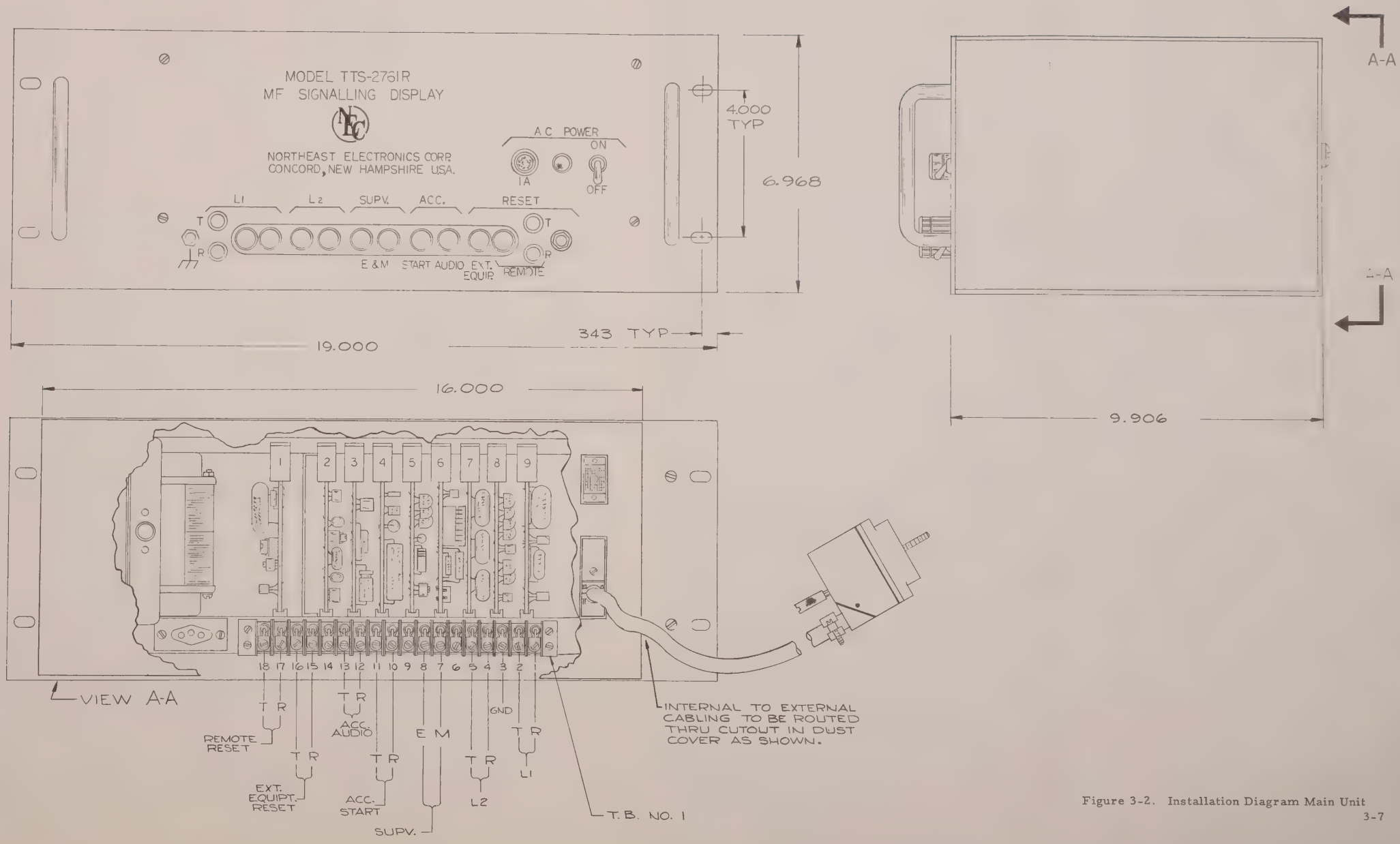


Figure 3-2. Installation Diagram Main Unit

SECTION 4

CIRCUIT DESCRIPTION

4.1 GENERAL. The operation of the TTS 2761 is illustrated in figure 4-1, the Overall Block Diagram. The unit performs four basic functions:

a. Display of MF Signal.

b. Display of DC Supervision.

c. Reproduction of audio.

d. Accessory functions.

4.2 BLOCK DIAGRAM DESCRIPTION. This section describes the basic functions of the set. A detailed description of the MF Signaling Processing is given in paragraphs 4.7 to 4.20.

4.3 DISPLAY OF MF SIGNALING.

a. Signals from the balanced L1 input are first fed through a high pass filter to remove power line interference. The filtered signals are then amplified (or attenuated) by an AGC (automatic gain control) amplifier, and a manual gain control amplifier. A junction FET switch, controlled by the AGC/MAN switch, selects one of the outputs. The chosen output is fed to six selective detectors (bandpass filters tuned to the MF frequencies followed by threshold detectors) that determine which MF tone - if any - are present and strong enough to be valid signals. This decision point marks the end of the analog signal processing. A logic 1 (high) output from a given detector indicates that the corresponding MF tone is being received.

b. The detector outputs are fed to a "2 and only 2 out of 6" decoder matrix. MF digit outputs are converted to BCD format to be compatible with the numeric display.

c. The decoded MF digit signals are then timed, gated into temporary storage, and fed through appropriate drivers to the display. MF digits are inhibited unless KP has been received since the last ST or the last Reset (Remote or Manual Reset operation).

d. The decoded MF codes are fed from the decoder to temporary storage, lamp drivers and the display. The codes can therefore be displayed at any time.

e. Individual outputs are routed from the selective detectors through lamp drivers to the display without storage.

f. The reset cycle can be triggered by a KP pulse, a Remote Reset input, or by a manual switch operation, depending upon the position of the RESET switch. A pulse is generated to clear the numeric display and all storage circuits.

4.4 DISPLAY OF SUPERVISION.

a. The E and M Supervision inputs are DC coupled to separate level detector circuits. The two-state outputs reflect (1) battery or open and (2) ground.

b. The level detector outputs are fed to the supervision lamp drivers.

4.5 REPRODUCTION OF AUDIO

a. Signals from the balanced L1 and L2 inputs are fed through separate high pass filters to identical soft limiting audio amplifiers. These circuits operate at reduced gain on high amplitude signals, thus tending to partially equalize the levels of audio. The outputs of the two amplifiers are summed and amplified again by the audio output amplifier. The combined audio is fed via twisted pair to the volume control and speaker located in the display unit.

4.6 ACCESSORY FUNCTIONS.

a. Accessory Start. The Accessory Start Relay provides an isolated contact closure controlled by the supervision inputs.

b. The outputs of both supervision level detectors are fed through an OR circuit to the relay coil. An off hook condition on either the E or M lead will operate the relay. Both the E and M leads must be in the on hook condition before the relay will release.

c. Accessory Audio. The combined L1 and L2 audio from the audio output amplifier is fed through an attenuator to the ACC AUDIO jack for use with accessory equipment. Output impedance is approximately 1 Kohm.

d. External Equipment Reset. An isolated contact closure is provided to reset accessory equipment (TN-76 for example) whenever the TTS 2761R receives a Remote Reset command or manual reset. The Remote Reset input and the manual contact of the Reset switch (display unit) are fed directly to the External Equipment Relay driver.

e. Accessory BCD Outputs. Data, control and lamp signals as well as the +5 volt supply, are fed to a 24 pin accessory connector. Data (digits 0-9) are in BCD format. Control signals - clear and data present - are in pulse form. Lamp signals are high/low but do not swing through the normal logic range. An appropriate interface must be used:

1. To operate properly from the non-standard lamp signals, and

2. To avoid distortion of display signals which might lead to errors in the TTS 2761R display.

4.7 MF SIGNAL PROCESSING. (Detailed description).

4.8 INPUT. As shown in figure 4-2, the MF input is balanced and DC blocked. A resistance is added in series with the transformer input to limit primary current and to increase the circuit input impedance. The transformer turns ratio is 5:1, introducing approximately 14 dB of voltage loss. Transient protection is provided by a varistor in the transformer secondary.

4.9 HIGH PASS FILTER. Intergrated circuit U1 on card 2 provides a 4 pole active high pass filter with 0 dB gain in band for supression of power line interference and harmonics. The cutoff frequency is approximatley 400 Hz.

4.10 AMPLIFICATION. Two types of amplification are available - automatic gain controlled (AGC) or manual gain controlled. Selection is made by a voltage controlled FET switch (Q1 and Q2) on card 3. A positive voltage (+12 V) on the MAN/AGC lead turns Q1 on and Q2 off, connecting the AGC output. A negative voltage (-12 V) on the MAN/AGC lead turns Q2 on Q1 off, connecting the manual gain control output.

4.11 AGC AND ASSOCIATED TIMING.

a. The AGC circuit maintains a nearly constant output amplitude over approximately 30 dB of input signal variation, greatly increasing the dynamic range of the unit. The filters and detectors which follow see a nearly constant input and thus maintain their characteristics over the full range.

b. AGC is achieved by varying the feedback path around U2A with the drain-source resistance of Q1. With no signal present, Q1 is turned on through R16. Its low R_{DS} and R14 form an attenuator which reduces any ac feedback to pin 2 of U2A by approximately 30 dB. Any signal received is amplified at full gain and coupled through C10 to two of the four inputs of U5. If the signal peaks exceed the offset voltages set up by the divider chain (R21, R23, R25, R27 and R28), the "normally off" sections of the two differential amplifiers in U5 will conduct - one on the positive peak and one on the negative peak. Since both conduct through R18, a greatly amplified full wave negative going signal appears across R18. The gate of Q1 is rapidly pulled negative, increasing the channel resistance, and decreasing the gain of the stage.

c. The circuit reaches a steady state within two or three cycles of signal at an output level such that the amplified peaks just exceed the offset voltages set by the divider.

d. The circuit returns to its original state over a much longer time (hundreds of milliseconds) controlled by R16 and C7.

e. A normally open FET switch is used to block idle line transients and initial surges caused by high level signals from the filters. Incoming signal amplitude must be sufficient to drive the gate voltage of Q1 more negative than an adjustable reference voltage set by R55 before the switch will close. R53 and R54 provide a slight positive feedback around the comparator U2B to prevent switch "chatter". Thus in addition to blocking initial transients, the circuit estalishes a fairly precise "threshold" below which signals will not be processed.

4.12 MANUAL GAIN CONTROL.

a. The Manual Gain Control circuit, located on card 3, employs current control of diode resistance in the input and feedback path of amplifier U1.

b. If the Manual Gain Control voltage is 0, both diodes CR3 and CR4 are off, and the stage gain is unity.

c. If the Manual Gain Control voltage goes positive, CR4 is back biased, but CR3 conducts. The dynamic resistance of CR3 and resistor R4 form an attenuator which reduces the feedback signal to pin 2 of U1 by up to 10 dB, thus increasing stage gain by up to 10 dB.

d. If the Manual Gain Control voltage goes negative, CR3 is back biased but CR4 conducts, decreasing the input signal amplitude and therefore stage gain by up to 10 dB.

4.13 SELECTIVE DETECTORS.

a. The amplified MF signal is fed to six selective detector circuits in parallel at about -27 dBm nominal. Each selective detector consists of a stagger tuned 4 pole active bandpass filter (U1A, U1B or U3A, U3B) followed by a two stage threshold detector (U2A, U2B or U4A, U4B).

b. Consider the circuit consisting of U1 and U2 (card 4, 5 or 6). The resonant frequency of each section of the filter (U1A, U1B) is determined by the Wien type network associated with it. For U1A, the network is C19, R54, R62 and C20, R55, R63. The Q of this section is controlled by the feedback network R27, R28 and R29. The fraction of the filter output fed to the threshold detector (U2), and thus the input level at which the detector will trip, is set by R36. The detector circuit is basically a fedback full wave bridge (U2A, CR4, CR5, C27, C28, R38, R41 and C32) with a fixed dc offset (R39, R43). When the average value of the full wave rectified signal exceeds the offset volatge, the output goes from low to high (U2B). The diodes CR6 and CR9 allow direct interface with logic circuits in the decoder (Card 7).

4.14 DECODER. (Card 7) The decoder fully decodes the detector outputs (normal and inverted) to the "2 out of 6" MF coding. MF digit outputs are converted to BCD on the same card. An inverted clock output is generated with each digit, KP and ST to trigger the pulse timing circuits on the Register.

4.15 REGISTER (Card 8). While it is possible for human voice energy or noise to activate two and only two selective detectors simultaneously, the probability of the event decreases as the required coincidence time increases. For this reason all digital MF pulses are timed for approximately 18 to 35 msec. before they are displayed. KP and ST pulses are timed before they are used to open or block the display path, but not before they are displayed. The other codes are considered less critical and are not timed.

4.16 PULSE WIDTH TIMER (Card 8). The pulse width timer circuits (Q1, Q2, Q3) start timing at the begining of each clock pulse. Capacitor C3 charges from ground toward +12V at a rate determined by the Pulse Width Gate control. The Schmitt trigger circuit (Q1, Q2) switches when (and if) C3 reaches approximately 6 volts. The leading edge of the transition turns off Q4 momentarily, producing a 10μsec positive pulse. The trailing edge toggles U2 (A, B) and turns off Q5. The "ripple" reaches Q6 about 20μsec after the initial transition, producing a 10μsec positive going "transfer" pulse.

4.17 RESET GENERATOR (Card 8). The Reset pulse generator (U1) produces a single negative going logic level pulse when its input (R1, R2) has been held low for approximately 15 msec. U2, the "D" register, the lamp storage circuits (Card 9) and the numeric display (via U4) are reset by this pulse.

4.18 DATA TRANSFER CONTROL (Card 8). The timing pulses are used in conjunction with KP and ST to control the display. MF digit data cannot be transferred into the "D" flip flop register (U5, U6) unless 1.) U2 is reset and 2.) the data pulse width exceeds the P.W. Gate setting. U2 may be reset by 1.) a KP pulse (KP reset mode), 2.) a remote reset pulse (remote reset mode) or 3.) a manual reset. Data pulses can then be transferred into the "D" register by the corresponding "transfer" pulses. The first data transfer pulse resets the "clear" flip flop (part of U4) allowing the numeric display to function. The transfer pulses are also used to trigger the numeric display via the "data present" pulse. When a valid ST is received, U2 is set, blocking the transfer path.

4.19 BUFFER AND STORAGE.

a. The "D" register provides temporary storage for MF digit data. The outputs are fed to data bus lines through open collector buffer (U8 Card 8) to allow multiple access to the display. The buss lines are fed to inverting line drivers (Card 9) to the numeric display.

b. Temporary storage for the MF codes is provided on the Buffer (Card 9) as Set/Reset flip flops (U7, U8, U9). The flip flop outputs are fed through non-inverting lamp drivers and current limiting resistors to the cathodes of the respective LED'S in the display unit. The LED anodes are tied to +5 V.

4.20 NUMERIC DISPLAY. The Burroughs Numeric Display requires positive BCD 5 volt logic inputs greater than 20 msec in length, a 5 μsec logic "0" "data present" pulse, and a 20 msec logic "0" "clear" pulse. The TTS 2761R provides the necessary logic inputs and supply voltages.

WARNING

Do not remove the termination board E95932 from the display without first mounting the metal shorting clip over the fingers of the lower display board.

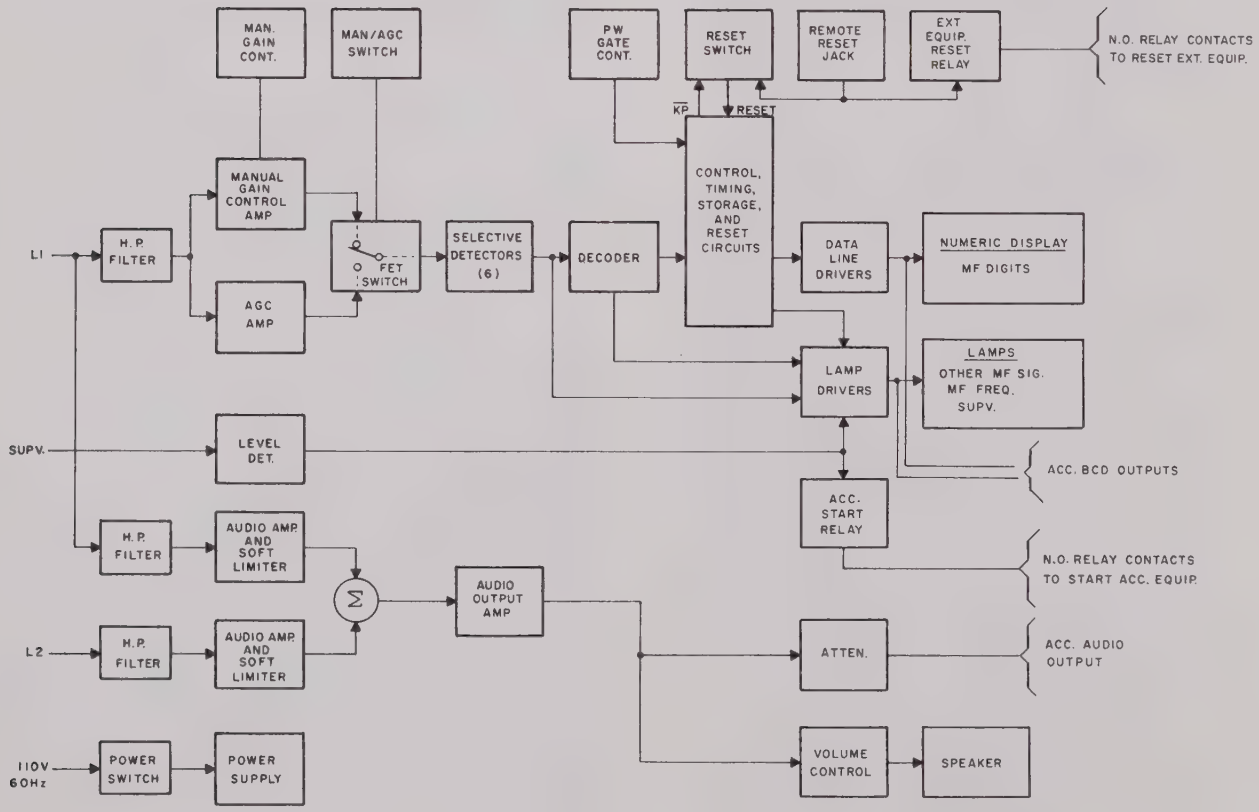


Figure 4-1. Overall Block Diagram

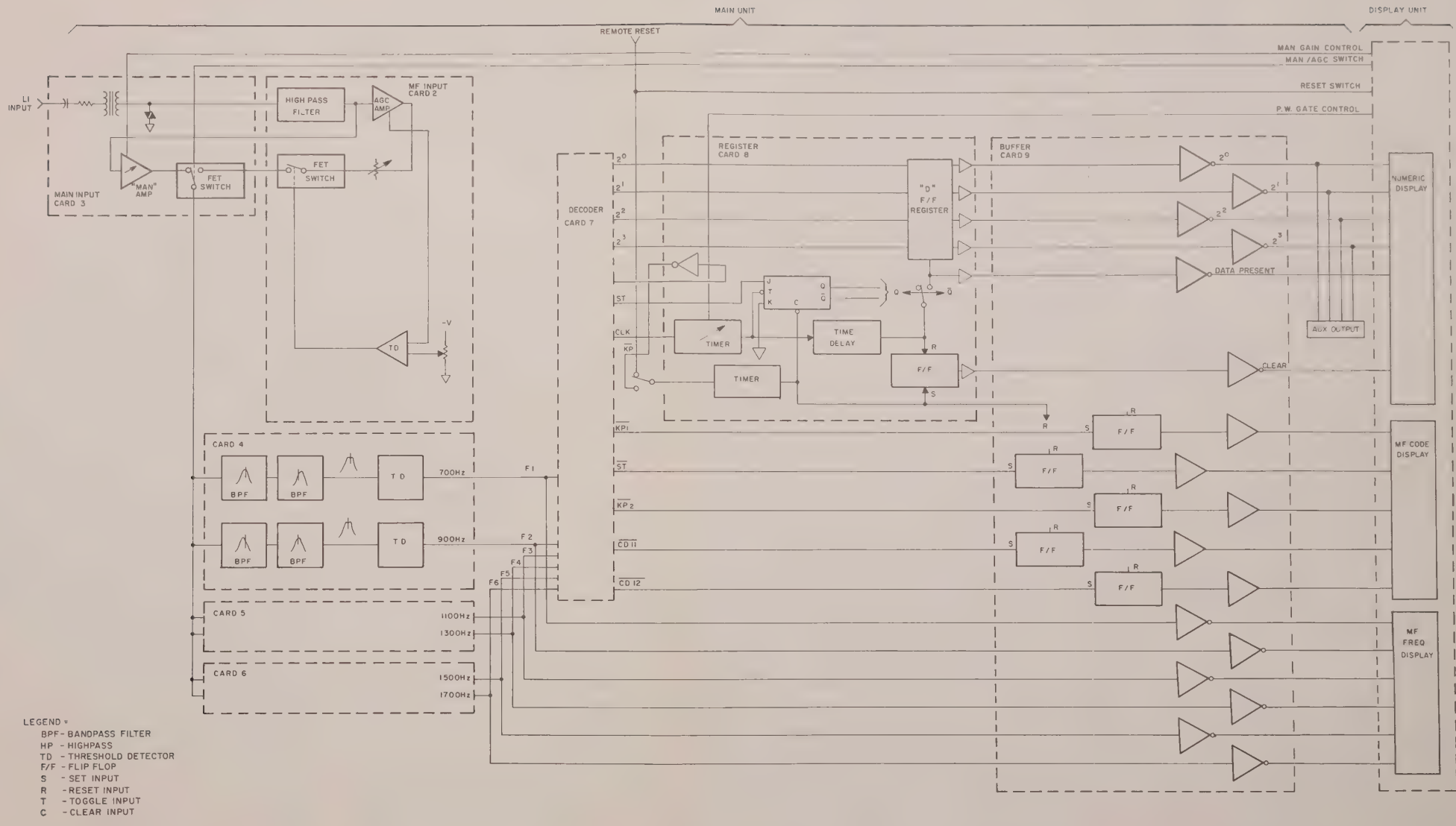


Figure 4-2. MF Signal Processing

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 GENERAL. Sufficient information is provided to allow simple maintenance and routine adjustment of power supply voltages if necessary. The user is advised to contact the factory for technical assistance and/or return of the equipment for factory repair if more complicated maintenance is required.

WARNING

Do not remove the termination board E95932 from the Burroughs display without first mounting the metal shorting clip over the fingers of the lower display board.

5.2 MALFUNCTIONS.

TABLE 5-1. MALFUNCTIONS

Malfunction	Possible Cause	Remedy
1. Power switch on, but power lamp off.	No 115 V ac to unit TTS 2761R fuse blown	Check source. Check with ohmmeter, replace with 1A Slo Blo.
2. POWER switch on, power lamp on, display not functioning, speaker dead.	Cable to remote display disconnected or damaged.	Check connections. Turn power off, remove and check cable pin by pin.
3. One or more MF Frequency display lamps on steadily.	Selective Detector latch up.	Turn power off for 5 sec, then on. Turn MAN gain down to prevent recurrence.
4. Power on, audio normal, numeric display flickering or dead.	B+ too low	Check +250 V. Reset to 250 $\pm$5 V if necessary.
5. Power on, audio and lamps OK, numeric display dead, +250 V supply at +300 V, no contorl.	B+ line open , Display defective	Consult factory
6. Power on, unit operation erratic.	Power supply problems.	Check all voltages.
7. Unit will not display MF, tones audible.	MAN/AGC switch in MAN position.	Increase gain or switch to AGC.
8. Unit works on MAN, will not display low level signals on AGC.	AGC threshold set too high.	Adjust R33 (card 2) full CCW. Consult factory.
9. Unit OK except no audio.	Faulty volume control, speaker	Check accessory audio for output with signal in on L1, L2 If good check signal at volume control, check speaker. If no accessory audio, check audio output amplifier.

5.3 POWER SUPPLY ADJUSTMENT.

5.4 EQUIPMENT REQUIRED

-Accurate DC voltmeter	- Triplett 630 Simpson 260 equivalent
-PC extender card	- Supplied by NEC
-AC oscilloscope	- Desirable but not essential
-AC voltmeter with DC blocking good for at least 250 volts.	- HP 400 Series, NEC Model 2000 desirable but not essential

WARNING

Lethal voltages are present in the supply during the operation and for several minutes after turnoff.

5.5 ADJUSTMENT.

NOTE

Make all voltage and ripple measurements between the indicated point and the negative side of C9 (ground).

a. Mount PC Card 1 on extender with components facing transformer.

b. Connect remote display via cable.

c. Turn power on.

d. Check +12 V supply at pin 21 of card or on positive side of C5. Adjust R16 for 12 $\pm$0.1V dc.

e. Check -12 V supply at pin 20 of card, on negative side of C6 or on R22. It should be -12 $\pm$0.25 V. The +12 V supply controls the -12 V level. There is no independent -12 V adjust.

f. Check +5 V supply on pin 22 of the card, the positive side of C9, or pin 2 of U4. The voltage should be +5 $\pm$0.15 V. There is no independent 5 V adjust.

g. Check the +250 V supply at the junction of C2 and R6. The voltage should be +250 $\pm$5 V. Adjust R7 to obtain this voltage if necessary.

Optional Check 1

h. Connect the oscilloscope to each of the supply outputs in turn. The pk-pk ripple voltage should be :

+12 V	$\leq$ 20 mV
-12 V	$\leq$ 20 mV
+5 V	$\leq$ 50 mV
+250 V	$\leq$ 2 V

Optional Check 2

i. Connect an average sensing AC voltmeter with suitable DC blocking to each of the voltage outputs in turn. The rms equivalent of the average measured ripple voltage should be (most VTVM's VOM's indicate rms volts but measure average volts):

+12 V	$\leq$ 15 mV
-12 V	$\leq$ 15 mV
+5 V	$\leq$ 35 mV
+250 V	$\leq$ 1.5 V

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following pages contain the parts list for the Model TTS 2761 MF Signalling Display.

6.2 FSCM CODE NUMBERS. This is the Federal Supply Code of Manufacturers as issued October 1969. A list of codes and their respective manufacturers is given below.

LIST OF MANUFACTURERS

Code No.	Manufacturer
01121	Allen Bradley Milwaukee, Wis. 53204
01295	Texas Instrument Inc. Dallas, Texas 75231
02660	Amphenol Corp. Broadview, Ill. 60153
04221	Midtex Inc. Mankato, Minn. 56001
05397	Union Carbide, Kemet Div. N.Y., N. Y. 10017
06486	IRC Division of TRW Lynn, Mass. 01905
09353	C&K Components Inc. Newton, Mass. 02138
12954	Dickson Electronics Corp. Scottsdale, Ariz. 85252
12065	Transitron Electric Corp. Boston, Mass. 02128
12697	Clarostat Mfg. Dover, N.H. 03820
13606	Sprague Electric Co. Concord, N. H. 03301
15873	Motorola Inc. Arcade, N.J. 14009
17538	Precision Electronics Mansfield, Mass. 02050
18324	Signetics Corp. Sunnyvale, Calif. 94086
19701	Electra/Midlands Mineral Wells, Texas
22650	Whale Electronics Nashville, Tenn.
22770	Allied Electronics Jersey City, N.J. 07304
44655	Ohmite Mfg. Co. Skokie, Ill. 60076
49671	RCA Corp. N.Y., N.Y. 10020
71590	Centralab Milwaukee, Wis. 53201
71785	Cinch Mfg. Co. and Howard B. Jones Div. Chicago, Ill. 60624
72136	Electro Motive Mfg. Willimantic, Conn. 06226
72982	Erie Technological Products Erie, Pa. 16521
73138	Beckman Instruments Heli-Pot Div. Fullerton, Calif. 92634
74199	Quam Nichols Co. Chicago, Ill 60637
75915	Littelfuse Inc. Des Planes, Ill. 60016
80223	United Transformer Co. N.Y., N. Y. 10013
80294	Bourns Inc. Riverside, Calif. 92507
81071	Schauer Mfg. Co. Cincinnati, Ohio 45242
81073	Grayhill, Inc. La Grange, Ill, 60525
82389	Switchcraft Inc. Chicago, Ill. 60630
83330	Smith Herman, H. Inc. Brooklyn, N.Y. 11207
90201	Mallory Capacitor Indianapolis, Ind. 46206
91662	Elco Corp. Willow Grove, Pa. 19090

PC Board E95875
Power Supply (Card 1)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R1	R: 10, 10%, $\frac{1}{4}$W	01121	CB
R2	R: 1.8K, 10%, $\frac{1}{4}$W	01121	CB
R3	R: 820K, 5%, $\frac{1}{2}$W	01121	EB
R4	R: 120K, 10%, 1W	44655	Little Devil
R5	R: 8.2K, 10%, $\frac{1}{2}$W	01121	EB
R6	R: 511K, 1%, $\frac{1}{4}$W	19701	MF6C
R7	R: 2K, pot, $\frac{1}{2}$W	73138	62P2K
R8	R: 23.7K, 1%, 1/8W	19701	MF5C
R9	R: 1M, 10%, $\frac{1}{4}$W	01121	CB
R10	R: 7.15K, 1%, 1/8W	19701	MF5C
R11	R: 47K, 10%, $\frac{1}{4}$W	01121	CB
R12	R: 2.7K, 10%, $\frac{1}{4}$W	01121	CB
R13	R: 1.0, 10%, $\frac{1}{2}$W	01121	EB
R14	R: 1.2K, 10%, $\frac{1}{2}$W	01121	EB
R15	R: 5.11K, 1%, 1/8W	19701	MF5C
R16	R: 1K, pot, $\frac{1}{2}$W	73138	62P1K
R17	R: 5.62K, 1%, 1/8W	19701	MF5C
R18	R: 2.7K, 10%, $\frac{1}{4}$W	01121	CB
R19	R: 1.0, 10%, $\frac{1}{2}$W	01121	EB
R20	R: 1.2K, 10%, $\frac{1}{2}$W	01121	EB
R21 and R22	R: 10K, 1%, 1/8W	19701	MF5C
R23	R: 2.7K, 10%, $\frac{1}{4}$W	01121	CB
R24	R: 0.39, 5%, 2W	06486	RC42
C1	C: 20μF, 400V, -10%, +50%	13606	39D206F350FL4
C2	C: 0.022μF, 400V, 10%	13606	4PS22
C3 and C4	C: 1100μF, 30V, -10%, +75%	13606	39D118G030GP4
C5 and C6	C: 4.7μF, 25V, 20%	05397	K4R7W25
C7	C: 2.2μF, 35V, 20%	05397	K2R2W35
C8	C: 4000μF, 15V, -10%, +75%	13606	39D408G025JT4
C9	C: 22μF, 6V, 20%	05397	K22W6
C10	C: 100μF, 16V	13606	TE1162
CR1 thru CR4	Diode	01295	1N2071
CR5	Rectifier ass'y	15873	MDA920A-2
CR6	Diode	12954	1N823 (6.2V)
CR7	Rectifier ass'y	15873	MDA920A-2
CR8	Rectifier ass'y	15873	MDA960-1
Q1	Transistor	49671	2N5416
Q2	Transistor	49671	2N3439
Q3	Transistor	15873	2N3905
Q4	Not used		
Q5 and Q6	Transistor	15873	2N3903
Q7	Not used		
Q8 and Q9	Transistor	15873	2N3905
Q10	Not used		
Q11	Transistor	15873	2N3903
Q12	Transistor	15873	2N2102
U1 thru U4	Integrated circuit	18324	N5741

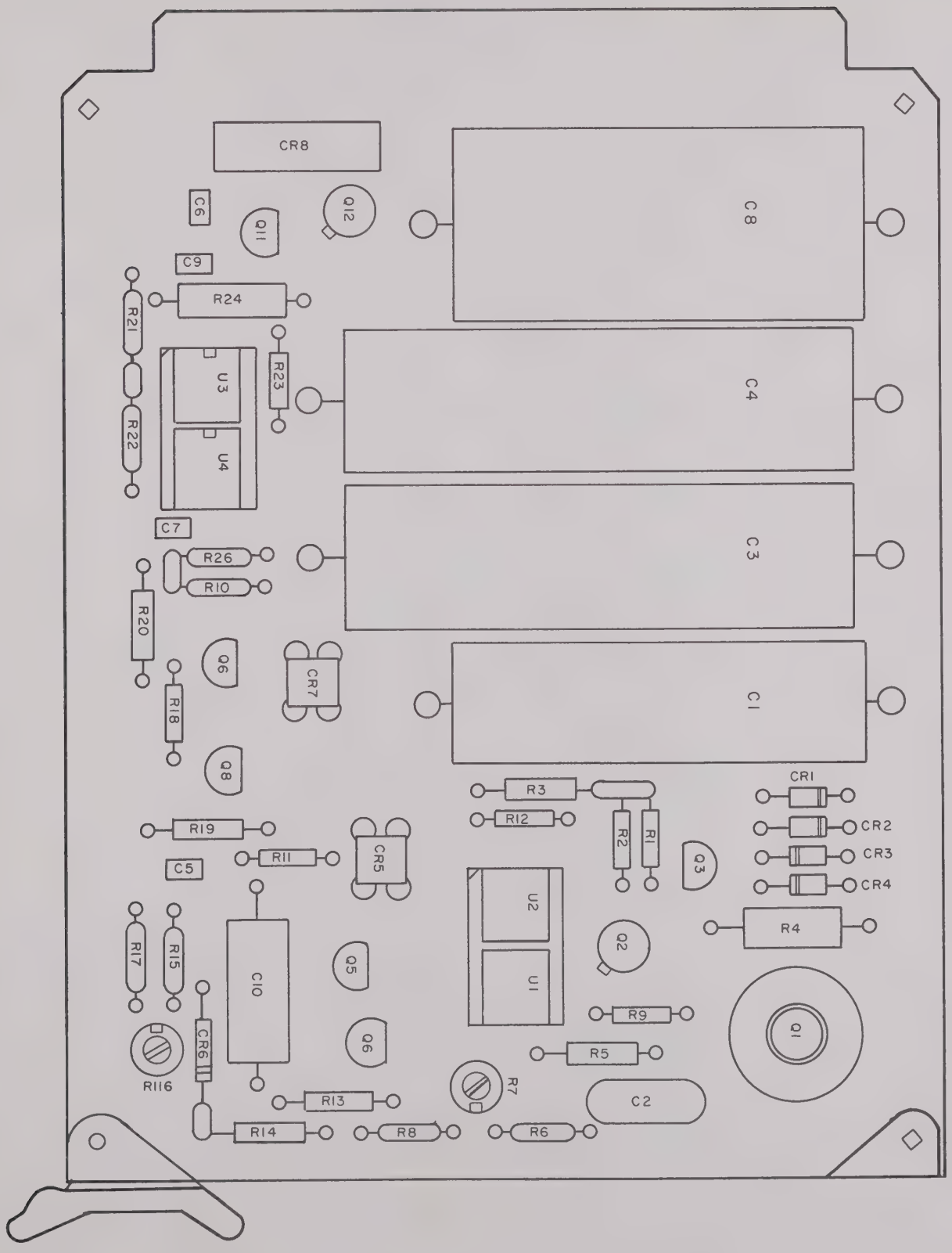


Figure 6-1. Card 1, E95875, Component Location

TTS 2761

P.C. Board E95883
MF Input (Card 2)

Ref Desig	Description	Manufacturer (FSCM Code No)	Part Number
R1	R: 38.3K, 1%, 1/8W	19701	MF5C
R2	R: 75K, 1%, 1/8W	19701	MF5C
R3	R: 22K, 10%, $\frac{1}{4}$W	01121	CB
R4	R: 1K, 10%, $\frac{1}{4}$W	01121	CB
R5	R: 38.3K, 1%, 1/8W	19701	MF5C
R6	R: 75K, 1%, 1/8W	19701	MF5C
R7	R: 22K, 10%, $\frac{1}{4}$W	01121	CB
R8	R: 1K, 10%, $\frac{1}{4}$W	01121	CB
R9	R: 3.9K, 10%, $\frac{1}{4}$W	01121	CB
R10	R: 1.8K, 10%, $\frac{1}{4}$W	01121	CB
R11	R: 100K, 10%, $\frac{1}{4}$W	01121	CB
R12	R: 10K, 10%, $\frac{1}{4}$W	01121	CB
R13 and R14	R: 47K, 10%, $\frac{1}{4}$W	01121	CB
R15	R: 10, 10%, $\frac{1}{4}$W	01121	CB
R16	R: 2.7M, 10%, $\frac{1}{4}$W	01121	CB
R17	R: 270, 10%, $\frac{1}{4}$W	01121	CB
R18	R: 3.3K. 10%, $\frac{1}{4}$W	01121	CB
R19	R: 1.5K, 10%, $\frac{1}{4}$W	01121	CB
R20	R: 5K, 10%, $\frac{1}{2}$W	73138	62P5K
R21	R: 6.8K, 10%, $\frac{1}{4}$W	01121	CB
R22	R: 2.2K, 10%, $\frac{1}{4}$W	01121	CB
R23	R: 120, 10%, $\frac{1}{4}$W	01121	CB
R24	R: 1K, 10%, $\frac{1}{4}$W	01121	CB
R25	R: 120, 10%, $\frac{1}{4}$W	01121	CB
R26 and R27	R: 2.2K, 10%, $\frac{1}{4}$W	01121	CB
R28	R: 3.3K, 10%, $\frac{1}{4}$W	01121	CB
R29 and R30	R: 1.5K, 10%, $\frac{1}{4}$W	01121	CB
R48	R: 3.9M, 10%, $\frac{1}{4}$W	01121	CB
R49	R: 100K, 10%, $\frac{1}{4}$W	01121	CB
R51	R: 560, 10%, $\frac{1}{2}$W	01121	EB
R52	R: 22K, 10%, $\frac{1}{4}$W	01121	CB
R53	R: 4.7M, 10%, $\frac{1}{4}$W	01121	CB
R54	R: 27K, 10%, $\frac{1}{4}$W	01121	CB
R55	R: 5K, 10%, $\frac{1}{2}$W	73138	62P5K
C1 thru C4	C: 0.01μF, 10%, 100V	13606	225P10391
C5	C: 1μF, 10%, 35V	05397	T330A105K035AS
C6	C: 15μF, 10%, 10V	05397	T330A156K010AS
C7	C: 2.2μF, 10%, 35V	05397	T330A225K035AS
C8 thru C10	C: 10μF, 10%, 10V	05397	T330A106K010AS
C14	C: 50μF, 10%, 20V	13606	TL1182
U1 and U2	Integrated circuit	18324	N5558V
U5	Integrated circuit	49671	CA3026
Q1	Transistor 2N5457	15873	MPF103
Q4	Transistor 2N5461	15873	MPF152
Q5	Transistor 2N5457	15873	MPF103
CR6	Diode	81071	SZ15.0
SV1	Varistor	81071	SV1

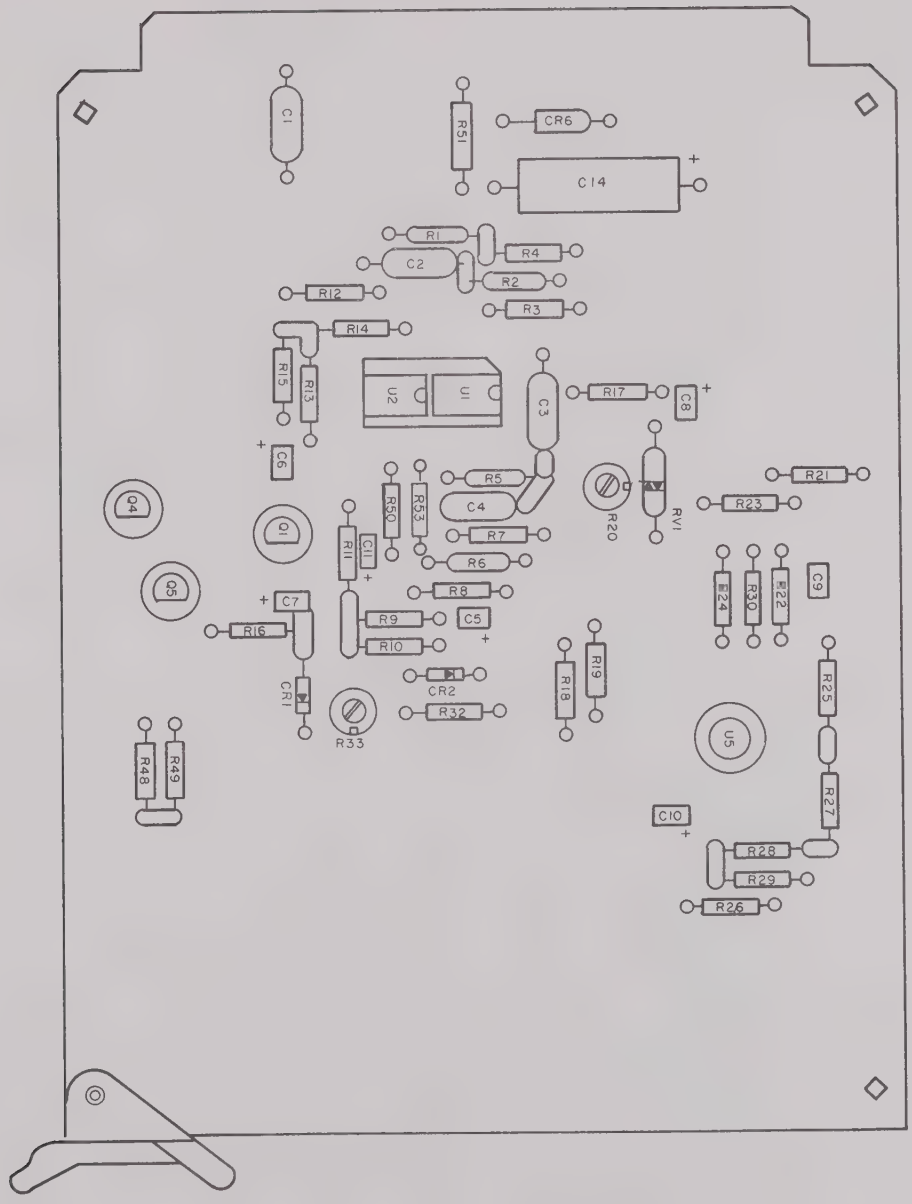


Figure 6-2. Card 2, E95883 Component Location

PC Board E95900-1
Main Input (Card 3)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R1	R: 5.11K, 1%, 1/8W	19701	MF5C
R2 and R3	R: 162, 1%, 1/8W	19701	MF5C
R4	R: 5.11K, 1%, 1/8W	19701	MF5C
R5 and R6	R: 16.2K, 1%, 1/8W	19701	MF5C
R7	R: 5K, Heli pot	73138	62P5K
R8	R: 22K, 10%, $\frac{1}{4}$W	01121	CB
R9 and R10	R: 1.0M, 10%, $\frac{1}{4}$W	01121	CB
R11 thru R14	R: 10K, 10%, $\frac{1}{4}$W	01121	CB
R15	R: 17.8K 1%, 1/8W	19701	MF5C
R16	R: 383K, 1%, 1/8W	19701	MF5C
R17	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
R18	R: 18K, 10%, $\frac{1}{4}$W	01121	CB
R19	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
R20	R: 22K, 10%, $\frac{1}{4}$W	01121	CB
R21	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
R22	R: 17.8K, 1%, 1/8W	19701	MF5C
R23	R: 383K,1%, 1/8W	19701	MF5C
R24	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
R25	R: 18K, 10%, $\frac{1}{4}$W	01121	CB
R26	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
R27	R: 47K, 10%, $\frac{1}{4}$W	01121	CB
R28	R: 22K, 10%, $\frac{1}{4}$W	01121	CB
R29 and R30	R: 39, 5%, $\frac{1}{2}$W	01121	EB
R31	R: 3.3K, 10%, $\frac{1}{4}$W	01121	CB
R32	R: 1.8K, 10%, $\frac{1}{4}$W	01121	CB
R33	R: 8.2K, 10%, $\frac{1}{4}$W	01121	CB
R34	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
R35	R: 10K, 10%, $\frac{1}{4}$W	01121	CB
R36 and R37	R: 470, 10%, $\frac{1}{4}$W	01121	CB
R38	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
C1 and C2	C: 50μF, 15V	13606	TE1160
C3	C: 0.01μF, 100V	13606	225P10391
C4	C: 0.022μF,	13606	225P22391
C5	C: 0.0022μF	13606	225P22291
C6 and C7	C: 0.022μF	13606	225P22391
C8	C: 0.0022μF	13606	225P22291
C9	C: 0.022μF	13606	225P22391
C10	C: 1μF, 35V	05397	K1W35K
C11	C: 0.047μF	13606	225P47391
C12	C: 0.047μF	13606	225P47391
C13	C: 1μF, 50V	72982	8131-050-651-105M
C14	C: 1μF, 35V	06397	K1W35K
C15	C: 0.0047μF	13606	225P47291
C16	C: 20μF, 15V, Non Polar	22650	12-375-20-15-8NA
CR1 thru CR9	Diode	12065	1N4148
RV1 thru RV4	Varistor	81071	SV-1
T1 and T2	Transformer	80223	S07P
K1	Relay	22770	RD1A
U1	Integrated circuit	18324	N5741V
U2 and U3	Integrated circuit	18324	N5558V
U4	Integrated circuit	18324	N5741V
Q1	Transistor	15873	2N5457
Q2	Transistor	15873	2N5461
Q3 and Q4	Transistor	15873	2N3903

PC Board E95900-1 (con't)
Main Input (Card 3)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
Q5	Transistor	49671	2N2102
Q6	Transistor	49671	2N4036
Q7 and Q8	Transistor	15873	2N3903

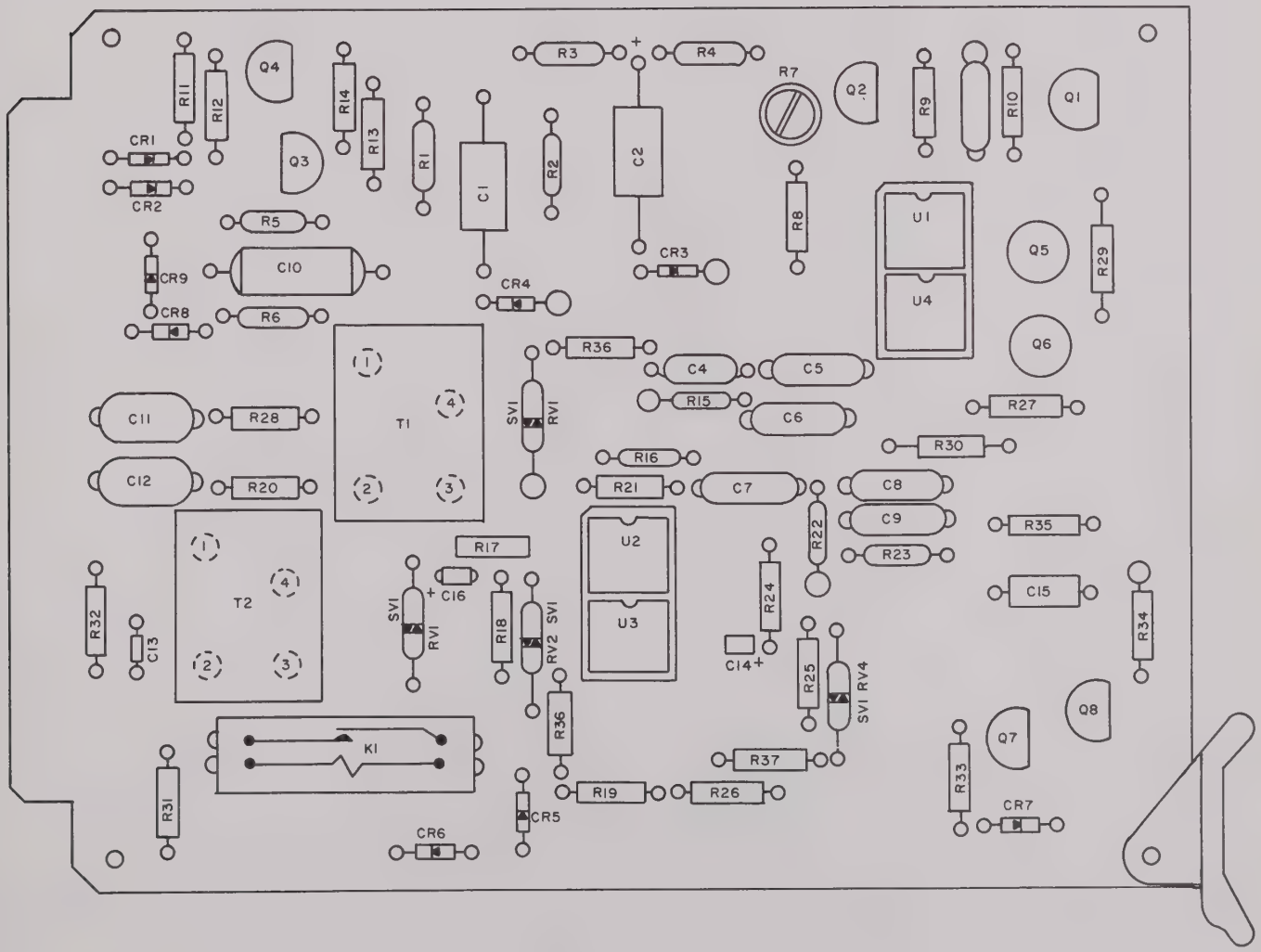


Figure 6-3, Card 3, E95900-1, Component Location

P.C. Board 96072
Dual Selective Detector, (Cards 4, 5, 6)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R4	R: 100K, 10%, $\frac{1}{4}$W	01121	CB
R5 and R6	Selected, 1%, 1/8W	19701	MF5C
R7 and R8	R: 1, 10%, $\frac{1}{2}$W (Cards 4, 5)	73138	72PM1K
R8	R: 500, 10%, $\frac{1}{2}$W (Card 6)	73138	66WR
R9 and R10	Selected, 1%, 1/8W	19701	MF5C
R11 and R12	R: 100K, 10%, $\frac{1}{4}$W	01121	CB
R13	R: 1, 10%, $\frac{1}{2}$W	73138	72PM1K
R14	Selected, 1%, 1/8W	19701	MF5C
R15	R: 1, 10%, $\frac{1}{2}$W (Cards 4, 5)	73138	72PM1K
R15	R: 500, 10%, $\frac{1}{2}$W (Card 6)	73138	66WR
R16 and R17	Selected, 1%, 1/8W	19701	MF5C
R18	R: 20K, 10%, $\frac{1}{2}$W	73138	66WR
R19	R: 100, 10%, $\frac{1}{4}$W (Cards 4, 5)	01121	CB
R20	R: 1M, 10%, $\frac{1}{4}$W	01121	CB
R21 thru R24	R: 100K, 10%, $\frac{1}{4}$W	01121	CB
R25	R: 220K, 10%, $\frac{1}{4}$W	01121	CB
R26	R: 10K, 10%, $\frac{1}{4}$W	01121	CB
R27	R: 100K, 10%, $\frac{1}{4}$W	01121	CB
R28	Selected, 1%, 1/8W	19701	MF5C
R29	R: 1, 10%, $\frac{1}{2}$W	73138	72PM1K
R30	Selected, 1%, 1/8W	19701	MF5C
R31	R: 1, 10%, $\frac{1}{2}$W (Cards 4, 5)	73138	72PM1K
R31	R: 500, 10%, $\frac{1}{2}$W (Card 6)	73138	66WR
R32 and R33	Selected, 1%, 1/8W	19701	MF5C
R34	R: 100K, 10%, $\frac{1}{4}$W	01121	CB
R35	Selected, 1%, 1/8W	19701	MF5C
R36	R: 1, 10%, $\frac{1}{2}$W	73138	72PM1K
R37 thru R39	Selected, 1%, 1/8W	19701	MF5C
R40	R: 1, 10%, $\frac{1}{2}$W	73138	72PM1K
R41	R: 20K, 10%, $\frac{1}{2}$W	73138	66WR
R42	R: 100, 10%, $\frac{1}{4}$W (Cards 4, 5)	01121	CB
R43	R: 1M, 10%, $\frac{1}{4}$W	01121	CB
R44 thru R47	R: 100K, 10%, $\frac{1}{4}$W	01121	CB
R48	R: 220K, 10%, $\frac{1}{4}$W	01121	CB
R49	R: 10K, 10%, $\frac{1}{4}$W	01121	CB
C1	C: 0.01μF, 10%, 100V	13606	225P10391
C2 thru C5	C: 0.31μF, 5%, 50V	27735	Type L
C6	C: 1.0μF, 10%, 5V	72982	8131-050-651-105M
C7 and C8	C: 0.1μF, 10%, 50V	05397	T330A104K050AS
C9	C: 0.01μF, 10%, 100V	13606	225P10391
C10 thru C13	C: 0.31μF, 5%, 50V	27735	Type L
C14	C: 1.0μF, 10%, 5V	72982	8131-050-651-105M
C15 and C16	C: 0.31μF, 5%, 50V	27735	Type L
U1 thru U4	Integrated circuit	18324	N5558V
Q1	Transistor	15873	MPS6515
Q2	Transistor	17803	2N3569
Q3	Transistor	15873	MPS6515
Q4	Transistor	17803	2N3569
CR1 thru CR6	Diodes	12065	1N4148

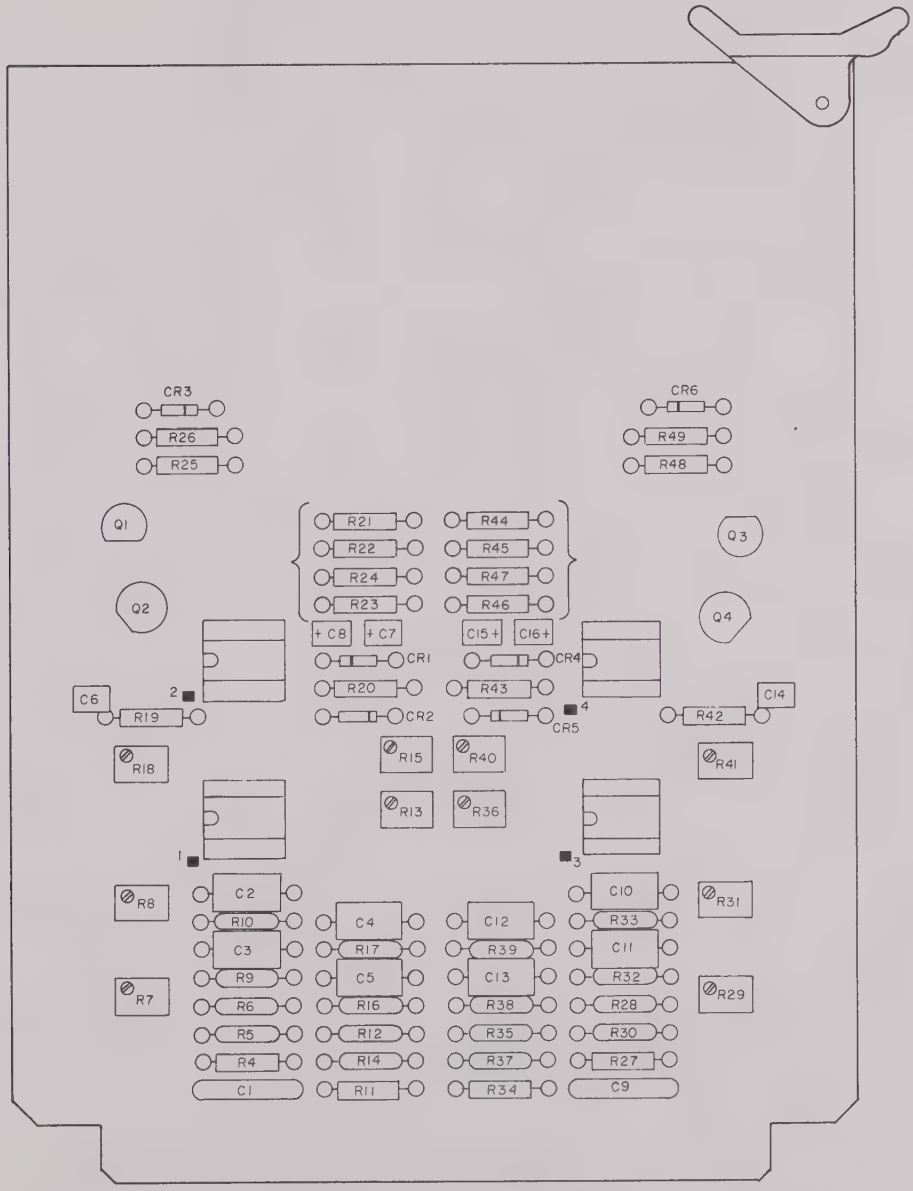


Figure 6-4. Cards 4, 5, and 6, 96072, Component Location

PC Board E95874-1
Decoder (Card 7)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R1 thru R6	R: 2.2K, 10%, $\frac{1}{4}$W	01121	CB
R7	R: 10K, 10%, $\frac{1}{4}$W	01295	SN7403
U1	Integrated circuit	15873	MC9718P
U2 thru U6	Integrated circuit	18324	SP377A
U7 thru U10	Integrated circuit	18324	SP384A
U11 thru U14	Integrated circuit	01295	SN7430N
U15	Integrated circuit	01295	SN7403

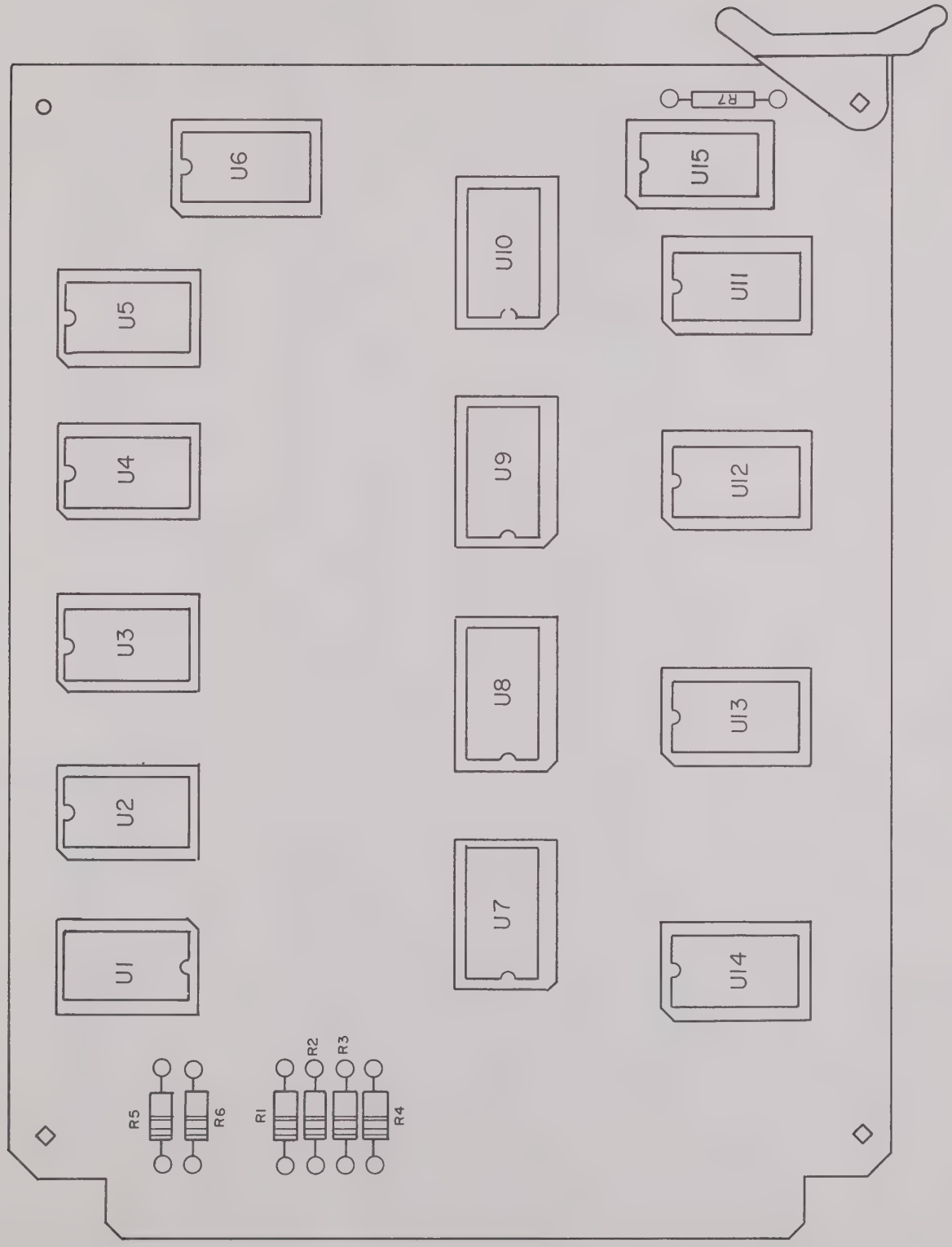


Figure 6-5. Card 7, E95874-1, Component Location

PC Board E95876
Register (Card 8)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R1	R: 5.62K, 1%, 1/8W	19701	MF5C
R2	R: 10K, 10%, $\frac{1}{4}$W	01121	CB
R3	R: 8.25K, 1%, 1/8W	19701	MF5C
R4	R: 750, 1%, 1/8W	19701	MF5C
R5	R: 28.7K, 1%, 1/8W	19701	MF5C
R6	R: 31.6K, 1%, 1/8W	19701	MF5C
R7	R: 2.61K, 1%, 1/8W	19701	MF5C
R8	R: 1.96K, 1%, 1/8W	19701	MF5C
R9 and R10	R: 10K, 10%, $\frac{1}{4}$W	01121	CB
R11	R: 47K, 10%, $\frac{1}{4}$W	01121	CB
R12	R: 5.6K, 10%, $\frac{1}{4}$W	01121	CB
R13	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
R14	R: 6.19K, 1%, 1/8W	19701	MF5C
R15	R: 1.33K, 1%, 1/8W	19701	MF5C
R16	R: 2.15K, 1%, 1/8W	19701	MF5C
R17	R: 1.8K, 10%, $\frac{1}{4}$W	01121	CB
R18	R: 22K, 20%, $\frac{1}{4}$W	01121	CB
R19	R: 51.1K, 1%, 1/8W	19701	MF5C
R20	R: 20K, pot	73138	62P20K
R21	R: 51.1K, 1%, 1/8W	19701	MF5C
R22	R: 10K, 10%, $\frac{1}{4}$W	01121	CB
R23	R: 1K, 10%, $\frac{1}{4}$W	01121	CB
R24	R: 10K, 10%, $\frac{1}{4}$W	01121	CB
R25	R: 22K, 10%, $\frac{1}{4}$W	01121	CB
R26	R: 1K, 10%, $\frac{1}{4}$W	01121	CB
R27	R: 22K, 10%, $\frac{1}{4}$W	01121	CB
R28	R: 2.7K, 10%, $\frac{1}{4}$W	01121	CB
R29	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
R30-R36	R: 10K,10%,$\frac{1}{4}$W	01121	CB
C1	C: 0.1μF, 50V	71590	T330A104K050AS
C2	C: 1000pF,1kV	13660	DD102
C3	C: 0.68μF, 35V	05397	KR68W35K
C4	C: 18pF	71590	DD-180
C5 thru C7	C: 1000pF,1kV	71590	DD102
C8	C: 4.7μF	05397	K4R7W25K
C9	C: 10μF	05397	K10W10K
CR1 thru CR3	Diode	12065	1N4148
U1	Integrated circuit	49671	CA3046
U2	Integrated circuit	01295	SN7473N
U3	Integrated circuit	18324	SP314
U4	Integrated circuit	01295	SN7400
U5 and U6	Integrated circuit	01295	SN7474N
U7	Integrated circuit	49671	CA3046
Q6	Transistor	15873	2N3903
Q7	Transistor	15873	2N3903
Q12 and Q13	Transistor	15873	2N3903

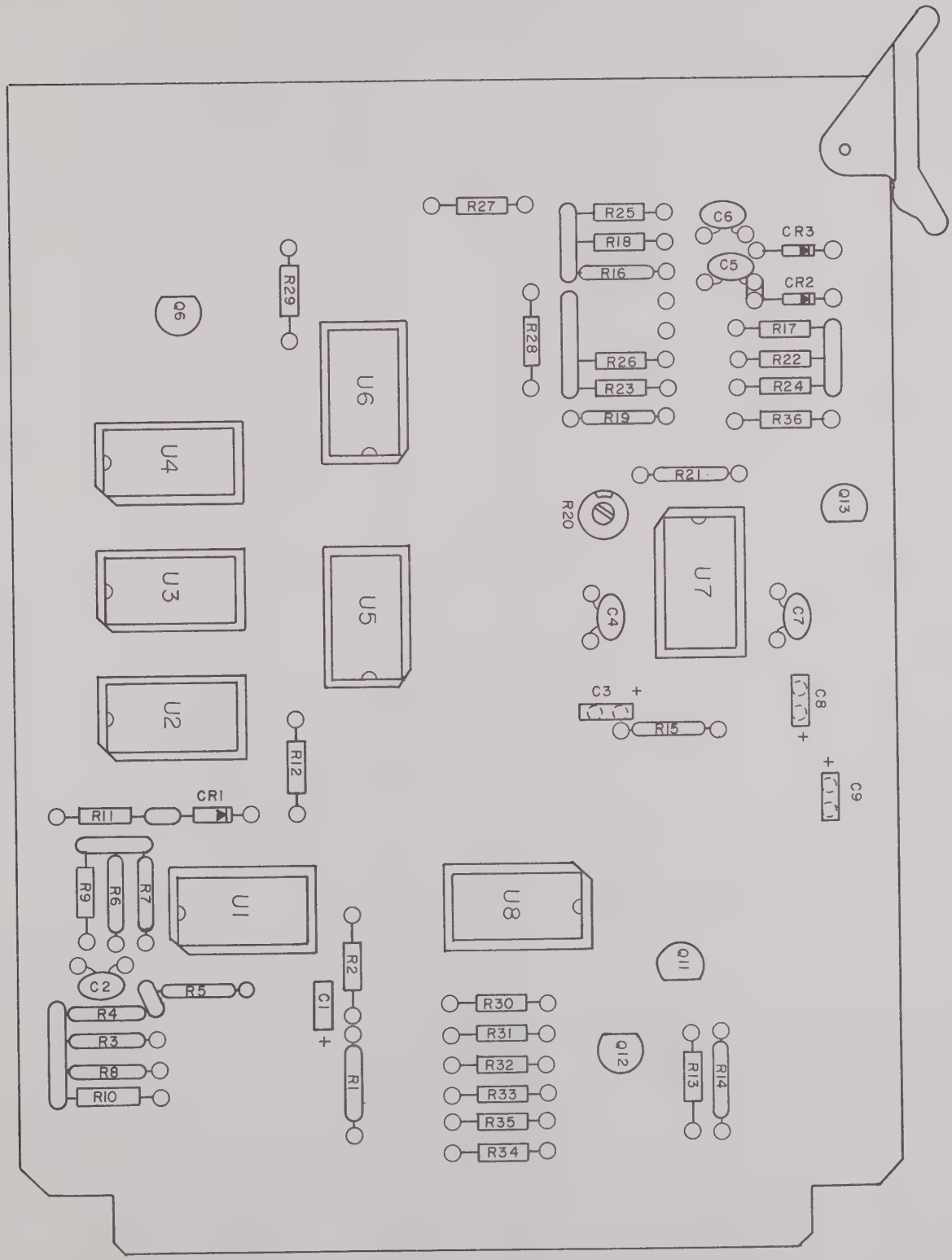


Figure 6-6. Card 8, E95876-1, Component Location

PC Board E95918-1
Buffer (Card 9)

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
R1 thru R5	R: 100, 10%, $\frac{1}{4}$W	01121	CB
R6	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
R7	R: 100, 10%, $\frac{1}{4}$W	01121	CB
R8	R: 1.8K, 10%, $\frac{1}{4}$W	01121	CB
R9	R: 2.7K, 10%, $\frac{1}{4}$W	01121	CB
R10	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
R11 thru R17	R: 100, 10%, $\frac{1}{4}$W	01121	CB
R18	R: 12, 10%, $\frac{1}{4}$W	01121	CB
C1	C: 50μF, 16V	13606	TE1160
C2	C: 22μF, 6V	05397	K22W6K
K1	Relay 12V	04221	181-12-B100
U1	Integrated circuit	01295	SN7407
U2 and U3	Integrated circuit	01295	SN7406
U4 thru U6	Integrated circuit	01295	SN7440
U7 thru U9	Integrated circuit	01295	SN7400

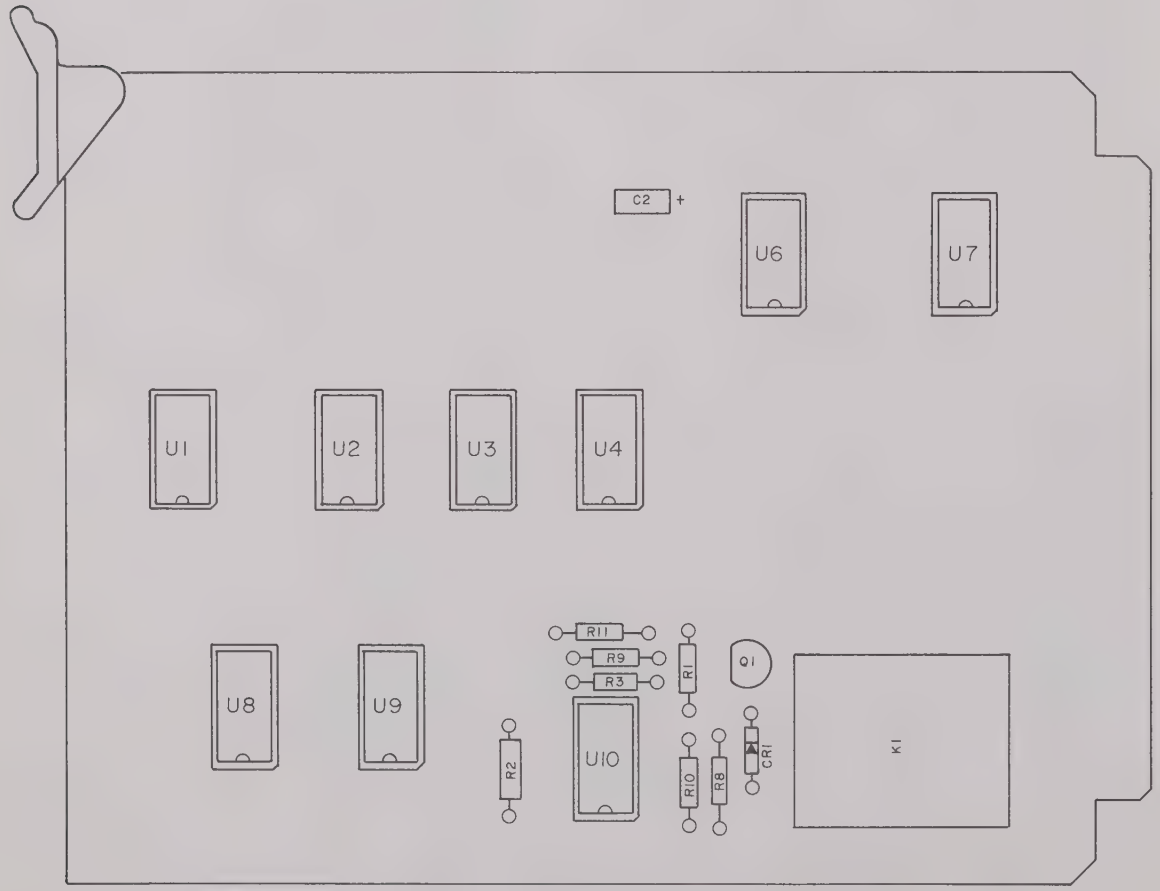


Figure 6-7. Card 9, E95918-1, Component Location

PC Board E95932
Termination Board (Card 11)

Ref Desig.	Description	Manufacturer (FSCM Code No,)	Part Number
R1	R: 47K, 10%, 1W	01121	GB
R2	R: 1K, 10%, $\frac{1}{4}$W	01121	CB
R3	R: 4.7K, 10%, $\frac{1}{4}$W	01121	CB
R4	R: 1.8K, 10%, $\frac{1}{4}$W	01121	CB
R5 thru R9	R: 3.3K, 10%, $\frac{1}{4}$W	01121	CB
C1	C: 0.022μF, 400V	13606	4PS-522
C2	C: 100μF, 16V	13606	TE1162
C3	C: 50μF, 20V	13606	TE1162
J1	Connector, 6 pin, dual rt angle	02660	225-20621-105

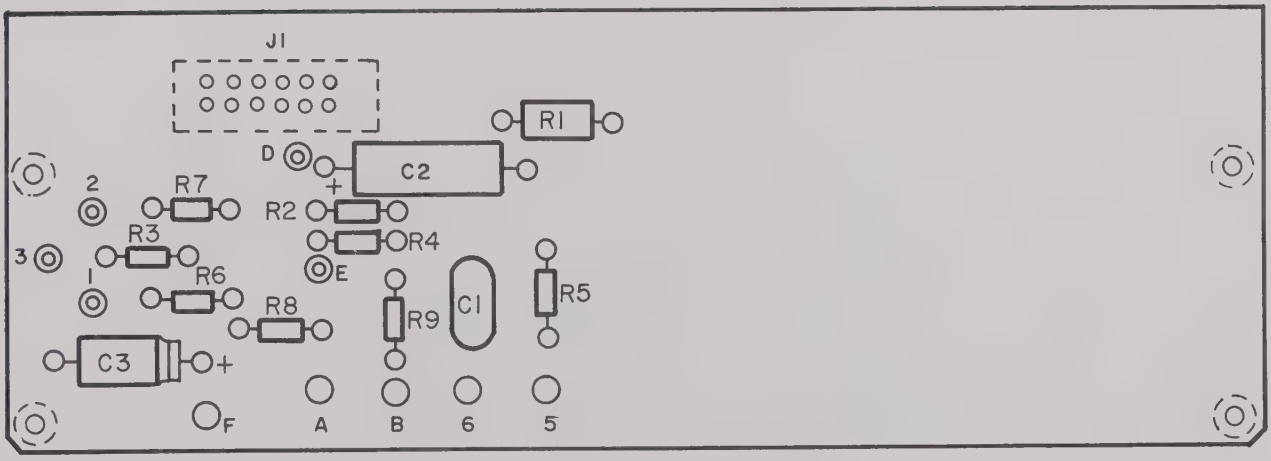


Figure 6-8. Card 11, E95932 Component Location

Main Assembly

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
J1	Connector, 22 pin	02660	225-22221-101
J2	Recept, 38 pin P-G-	91662	00-8016-038-000-707
J3	Recept, 20 pin	91662	00-8016-020-000-707
J4	Binding post, red	81073	29-1R
J5	Binding post, black	81073	29-1B
J6 and J7	L1	82389	5J-1329
J8 and J9	L2	82389	5J-1329
J10 and J11	E&M	82389	5J-1329
J12	Acc start	82389	5J-1329
J13	Acc audio	82389	5J-1329
J14	Reset ext. equip	82389	5J-1329
J15	Remote reset	82389	5J-1329
J16	Binding post, red	81073	29-1R
J17	Binding post, black	81073	29-1B
J18 and J19	Ground post	83330	137SP
J20	AC recept	82389	AC3G
S1 and S2	Switch	09353	7101
TB1	Terminal bd, 18 pin	71785	18-140-Y
F1	Fuse, 1A	75915	3AG
R1	R: 150K, pot	44655	CU1541
R2	R: 5K, pot	44655	CU5201
R3	R: 1K, pot	44655	CU1021
R4	R: 47, 10%, $\frac{1}{2}$W	01121	EB

Remote Readout Assembly

Ref Desig.	Description	Manufacturer (FSCM Code No.)	Part Number
J1	Connector, 38 pin	91662	00-8016-038-000-702
R1	5K, pot	12697	CM30154NP
R2	150K, pot	44655	CU1541
R3	1K, pot	90201	MR-1000B
R4	47, 10%, $\frac{1}{2}$W	01121	EB
LS1	Speaker	74199	25A07Z45
S1	Switch	09353	7101
S2	Switch	09353	7213
	Self Scan Display, Burroughs Corp. Plainfield, N.J. 07061	83594	

PC Board E95936
E&M Lamp Board

Ref Desig	Description	Manufacturer (FSCMCode No.)	Part Number
DS1 and DS2	Light emitting diode	Litronix	Red Lite 2
R1 and R2	Resistor	01121	CB

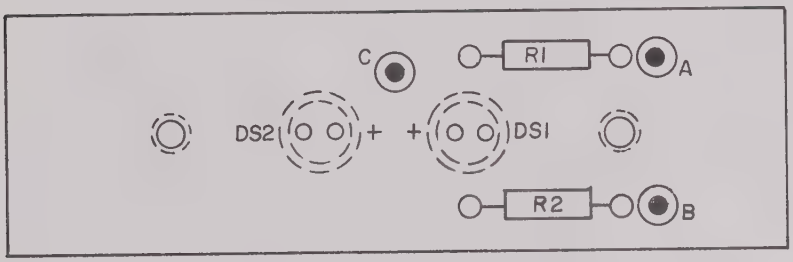


Figure 6-9. PC Board E95936 Component Location

PC Board E95937
Frequency Lamp Board

Ref Desig	Description	Manufacturer (FSCM Code No.)	Part Number
DS1 thru DS6	Light emitting diode	Litronix	Red Lite 2
R1 thru R6	Resistor	01121	CB

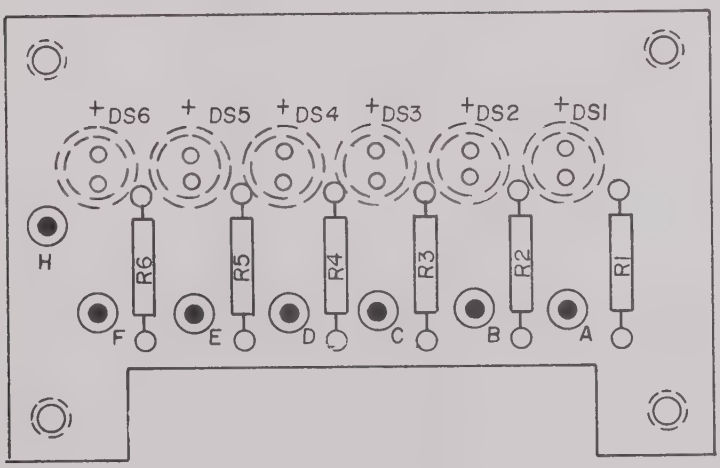


Figure 6-10. PC Board E95937 Component Location

PC Board E95935
KP Lamp Board

Ref Desig	Description	Manufacturer (FSCM Code No.)	Part Number
DS1 thru DS5	Light emitting diode	Litronix	Red Lite 2
R1 thru R5	Resistor	01121	CB

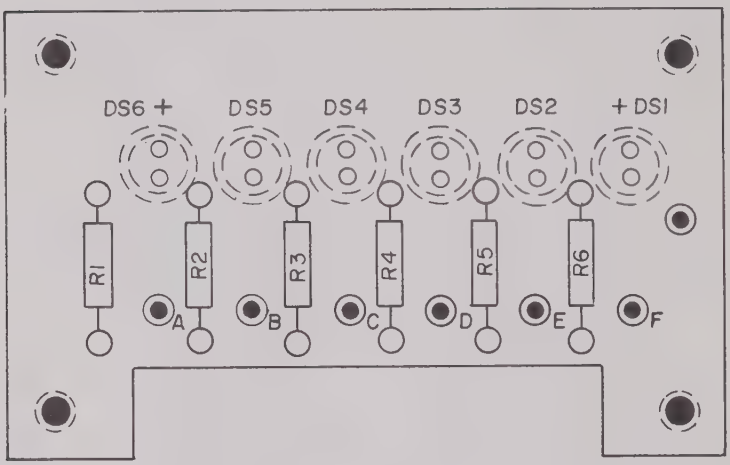


Figure 6-11. PC Board E95935 Component Location

Transformer Assembly

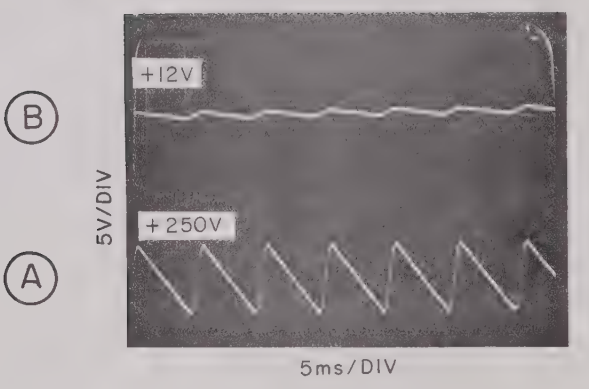
Ref Desig	Description	Manufacturer (FSCM Code No.)	Part Number
T1	Transformer	17538	NEC-4
Q4	Transistor	49671	2N4910
Q8	Transistor	49671	2N4898
Q10	Transistor	49671	2N3055
J1	Connector, 22 pin	02660	225-22221-101

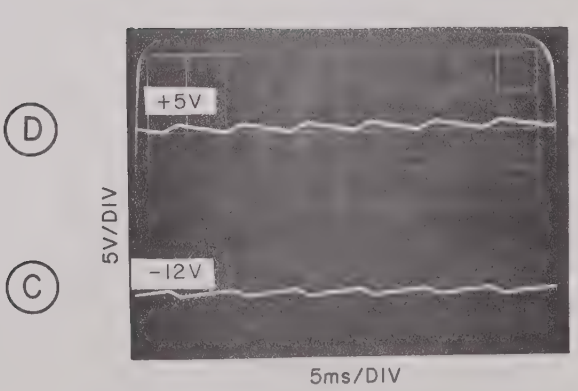
SECTION 7

SCHEMATIC DIAGRAMS

7.1 INTRODUCTION.

7.2 The following pages contain the schematic diagrams for the Model TTS 2761 MF Signalling Display.





Waveforms for Figure 7-1

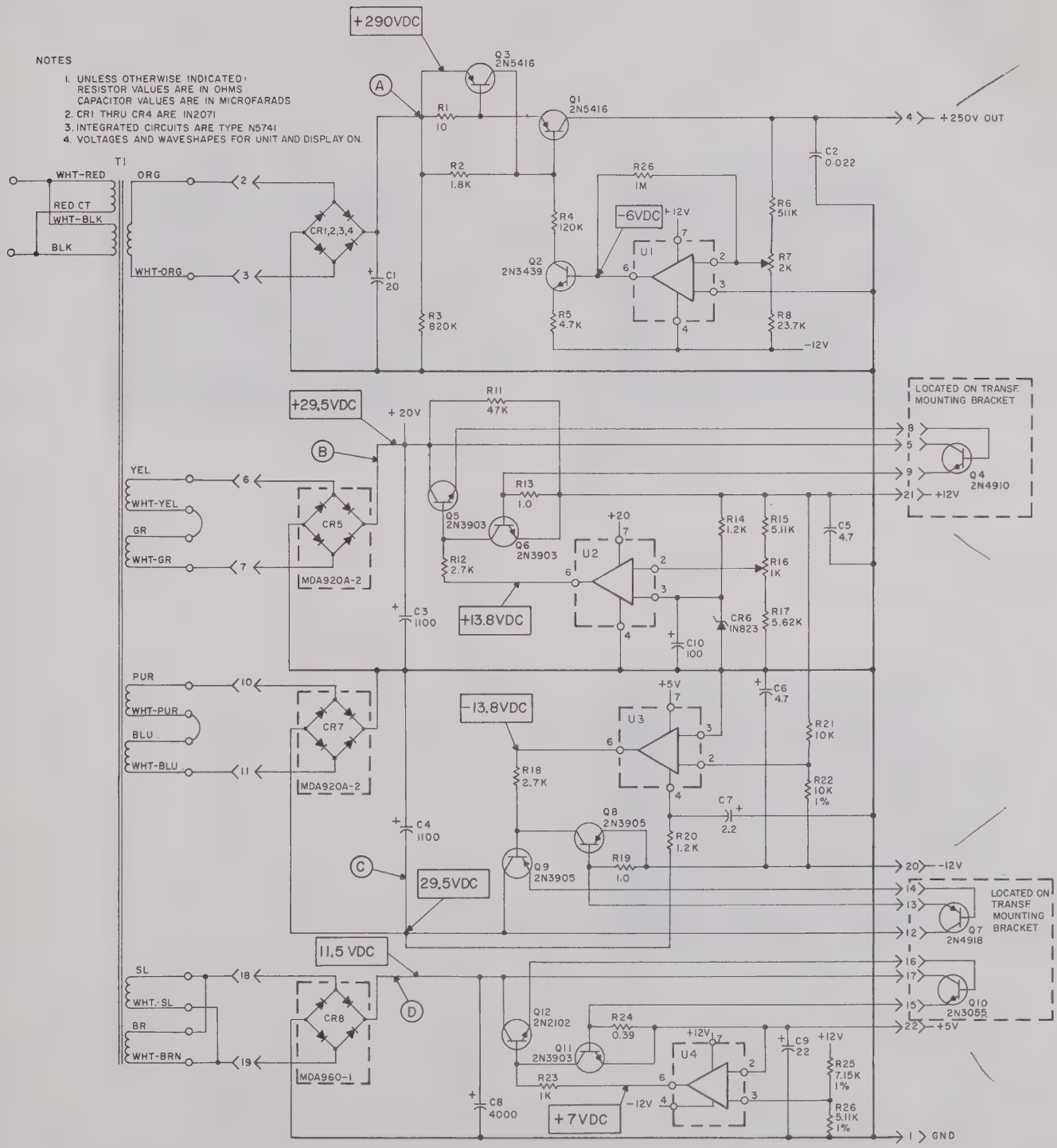
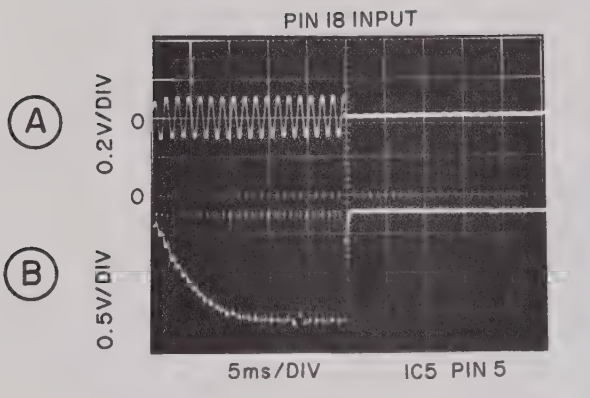
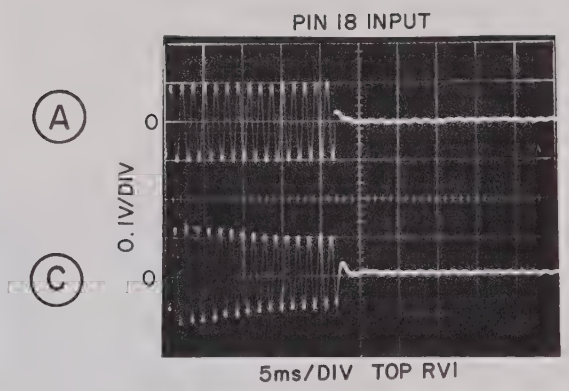
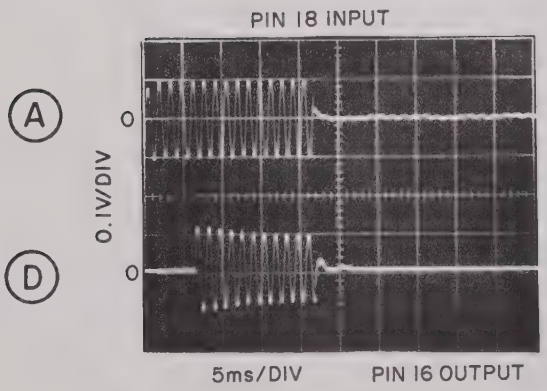


Figure 7-1. Schematic Diagram, Power Supply, E95875, (Card 1)







Waveforms for Figure 7-2

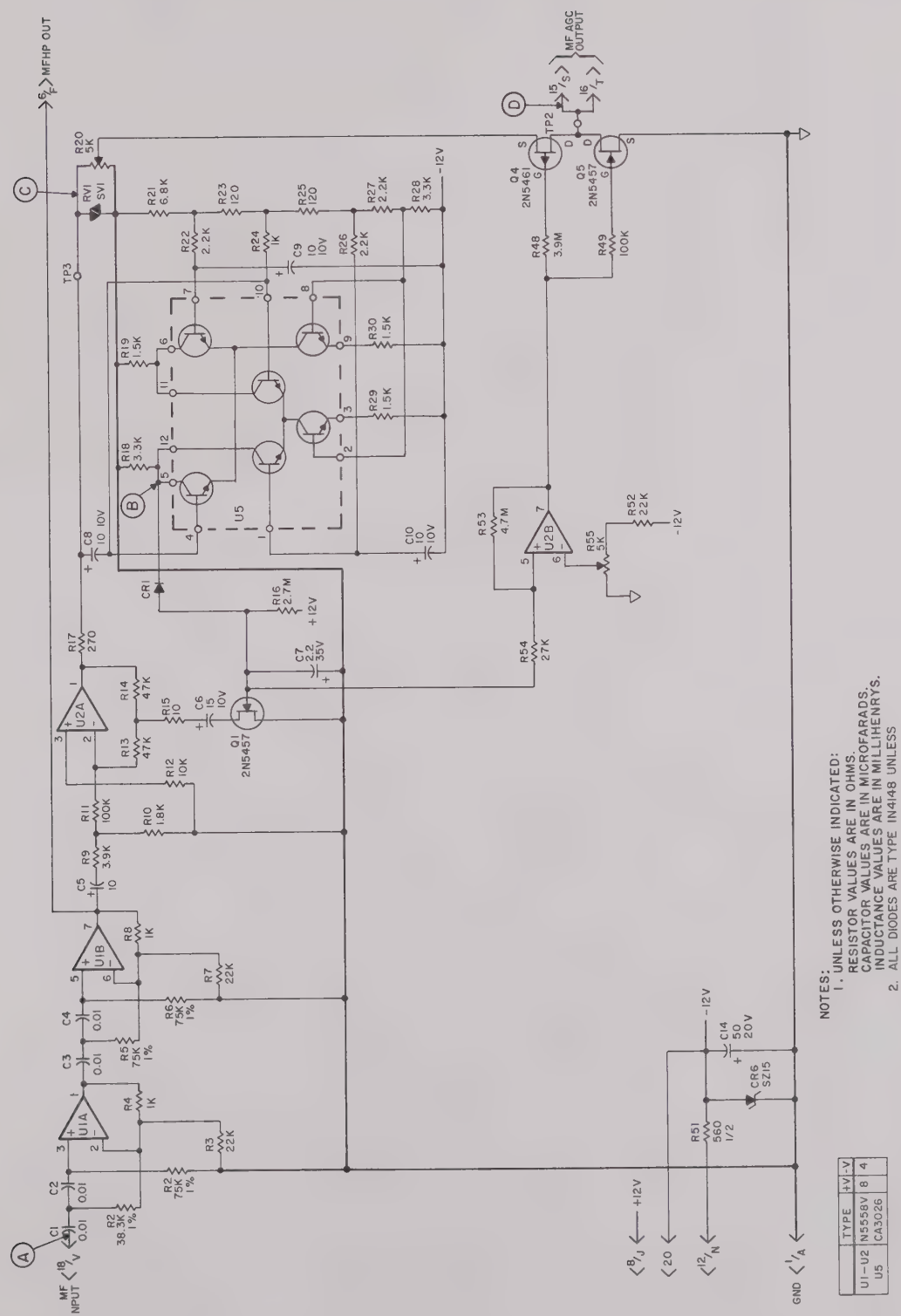


Figure 7-2. Schematic Diagram, MF Input, E95883, (Card 2)

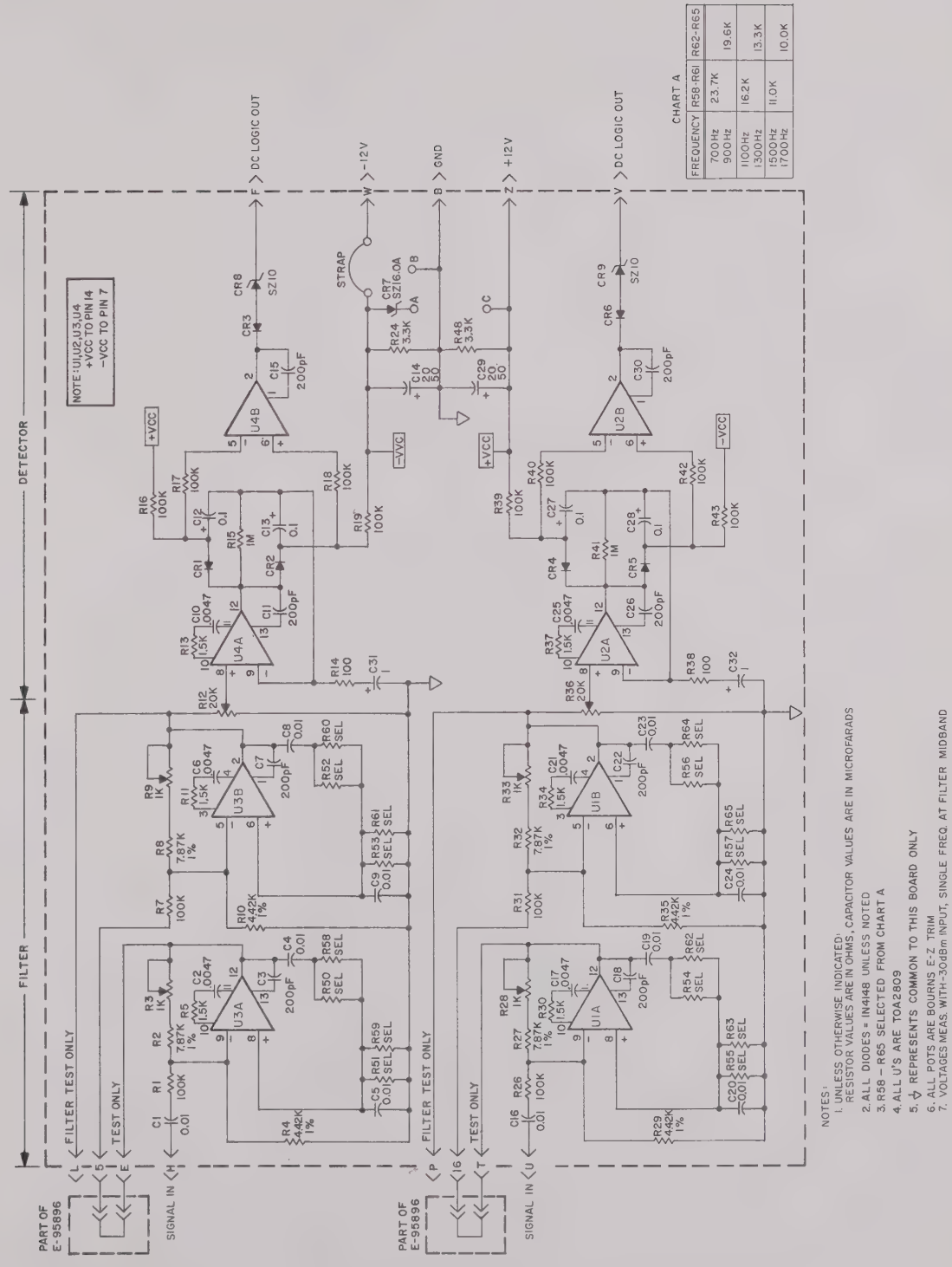
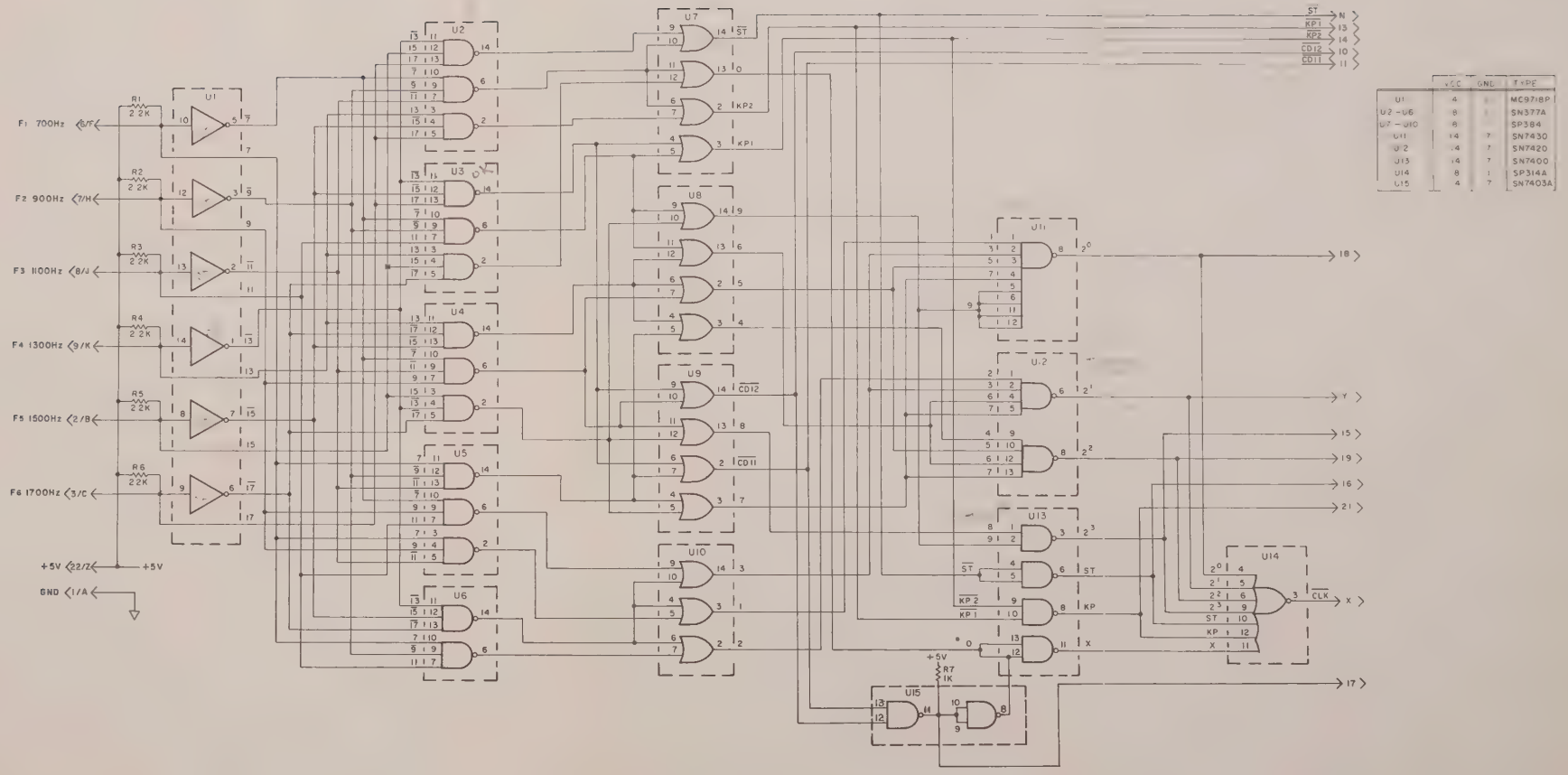

DETECTOR
FILTER
F > DC LOGIC OUT
W > -12V
B > GND
Z > +12V
V > DC LOGIC OUT
NOTE: U1,U2,U3,U4 +VCC TO PIN 14 -VCC TO PIN 7
STRAP
CHART A
FREQUENCY | R58-R61 | R62-R65
700Hz 900Hz | 23.7K | 19.6K
1100Hz 1300Hz | 16.2K | 13.3K
1500Hz 1700Hz | 11.0K | 10.0K
FILTER TEST ONLY
TEST ONLY
SIGNAL IN
PART OF E-95896
NOTES:
1. UNLESS OTHERWISE INDICATED: RESISTOR VALUES ARE IN OHMS, CAPACITOR VALUES ARE IN MICROFARADS
2. ALL DIODES = IN4148 UNLESS NOTED
3. R58 - R65 SELECTED FROM CHART A
4. ALL U'S ARE TOA2809
5. ⏚ REPRESENTS COMMON TO THIS BOARD ONLY
6. ALL POTS ARE BOURNS E-Z TRIM
7. VOLTAGES MEAS. WITH -30dBm INPUT, SINGLE FREQ. AT FILTER MIDBAND

Figure 7-4. Schematic Diagram, Selective Detector, (Card 4,5 and 6)



	VCC	GND	TYPE
U1	4	11	MC9718P
U2 – U6	8	1	SN377A
U7 – U10	8	1	SP384
U11	14	7	SN7430
U12	14	7	SN7420
U13	14	7	SN7400
U14	8	1	SP314A
U15	4	7	SN7403A

Figure 7-5. Schematic Diagram MF Decoder, E95874-1, (Card 7)

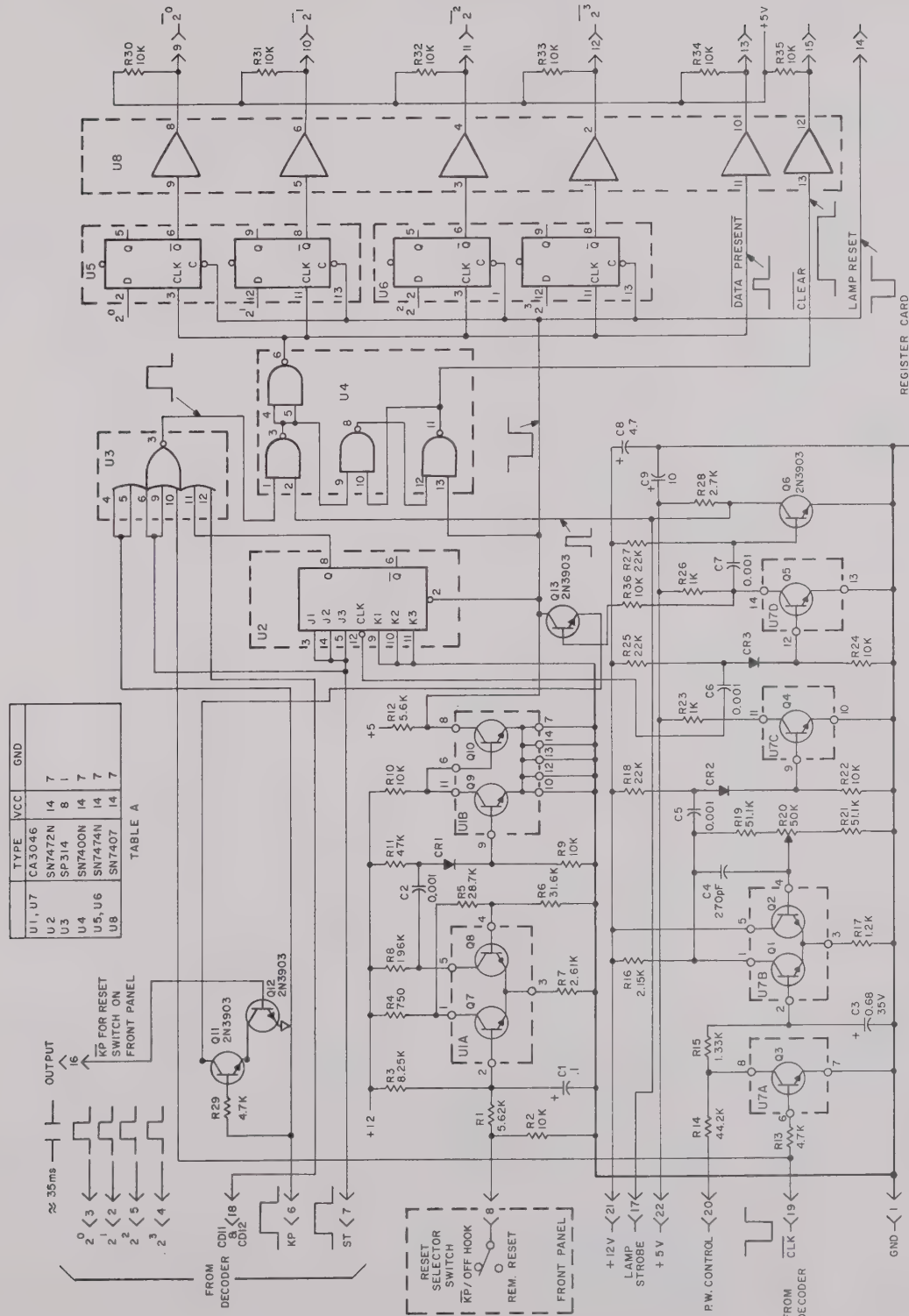
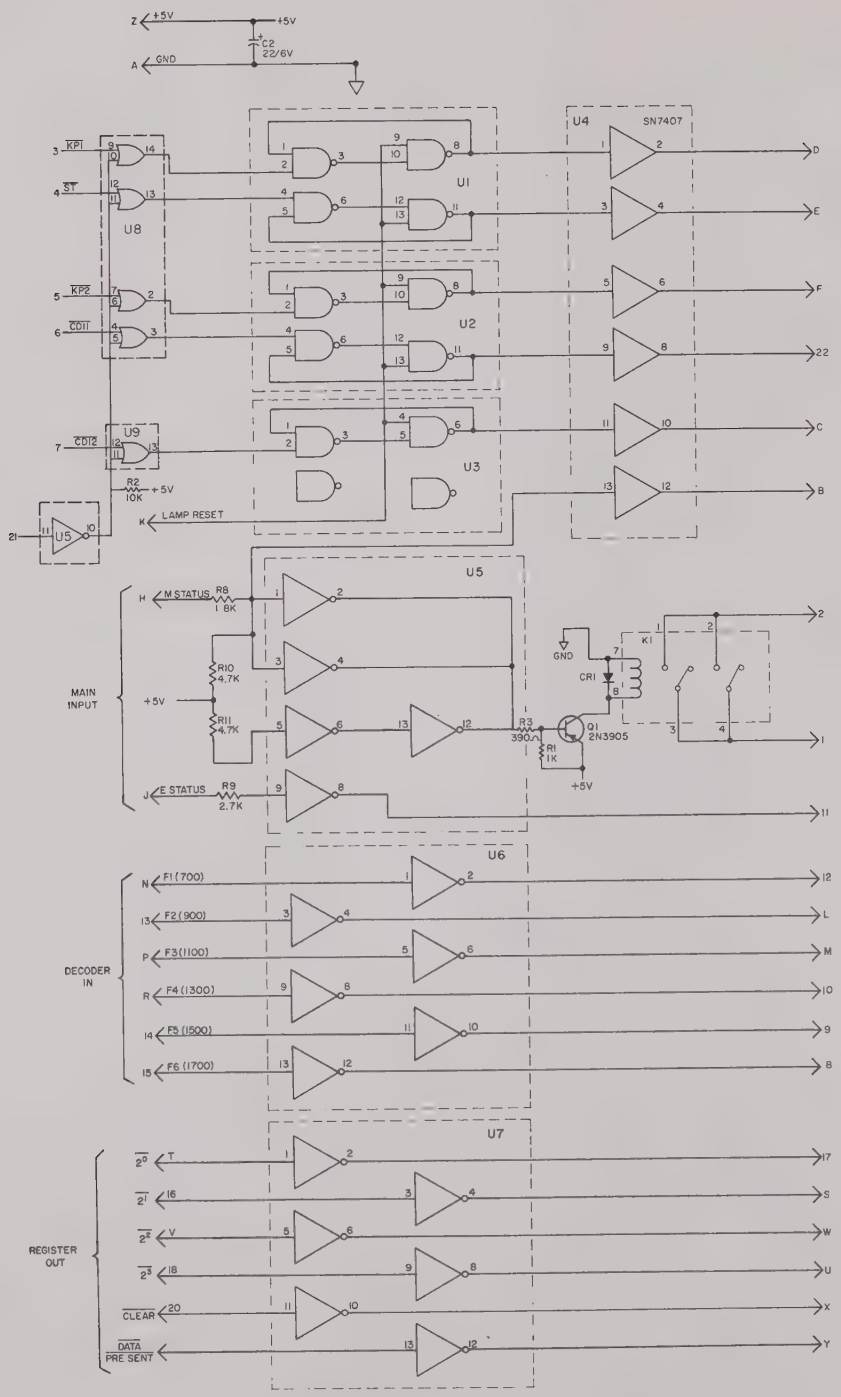


Figure 7-6. Schematic Diagram, Register, E95876-1 (Card 8)



I.C.	TYPE	GND	VCC
U1,U2 AND U3	SN7400	7	14
U4	SN7407	7	14
U5 AND U6	SN7406	7	14
U7	SN7404	7	14
U8,9	SP384	1	8

Figure 7-7. Schematic Diagram, Buffer, E95918, (Card 9)

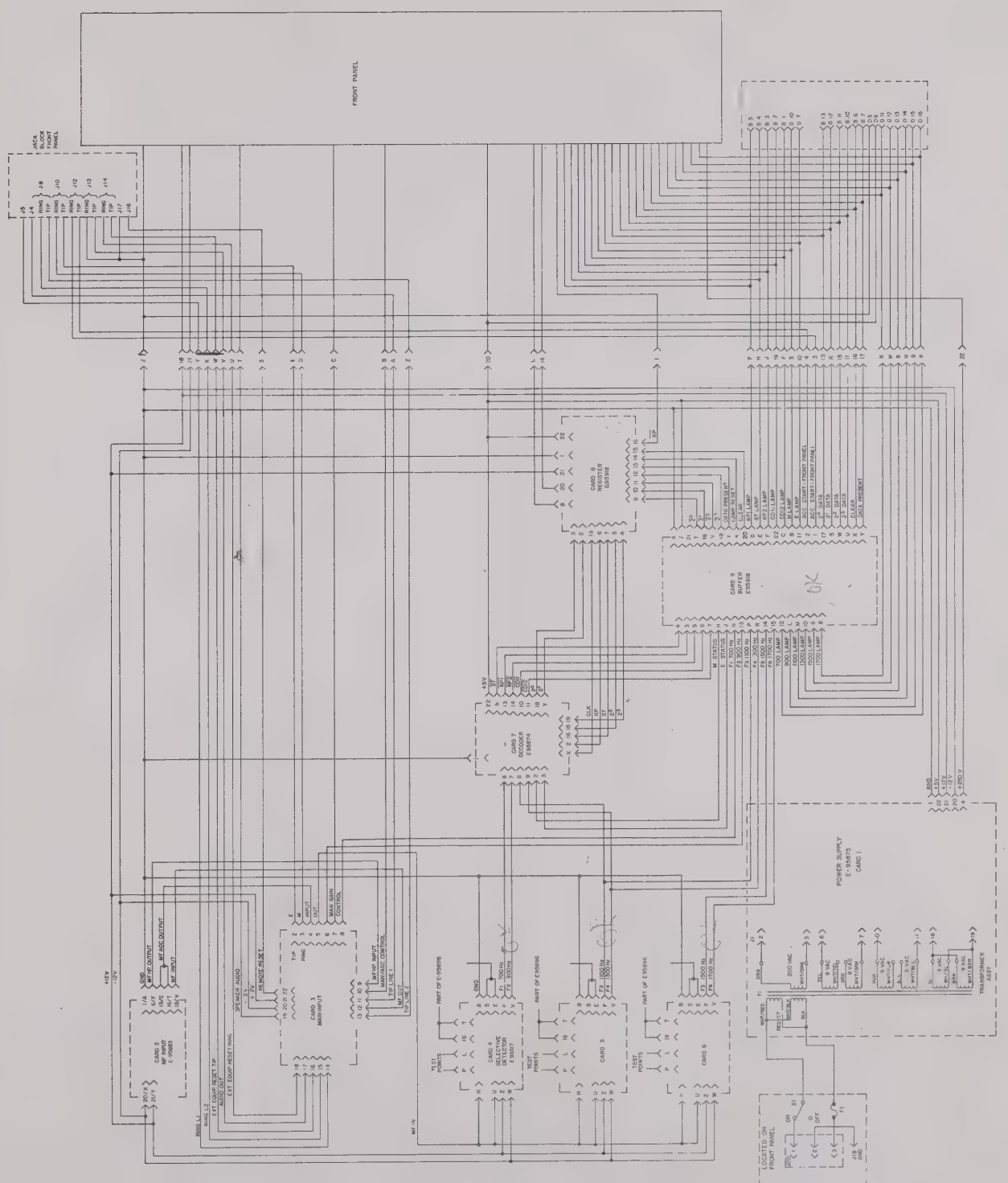


Figure 7-8. Signal And Power Distribution Model TTS 2761

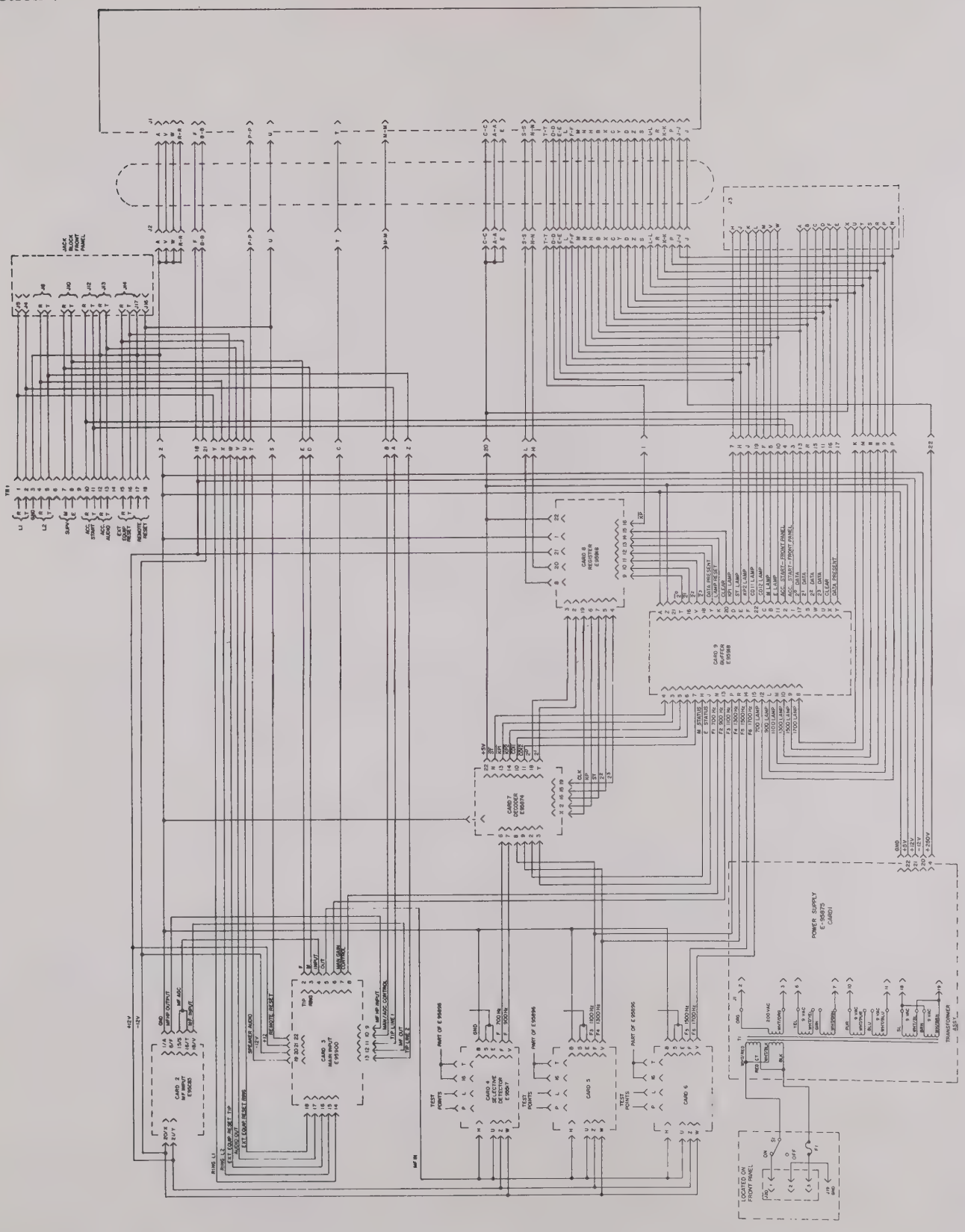


Figure 7-9. Model TTS 2761R Signal and Power Distribution Diagram

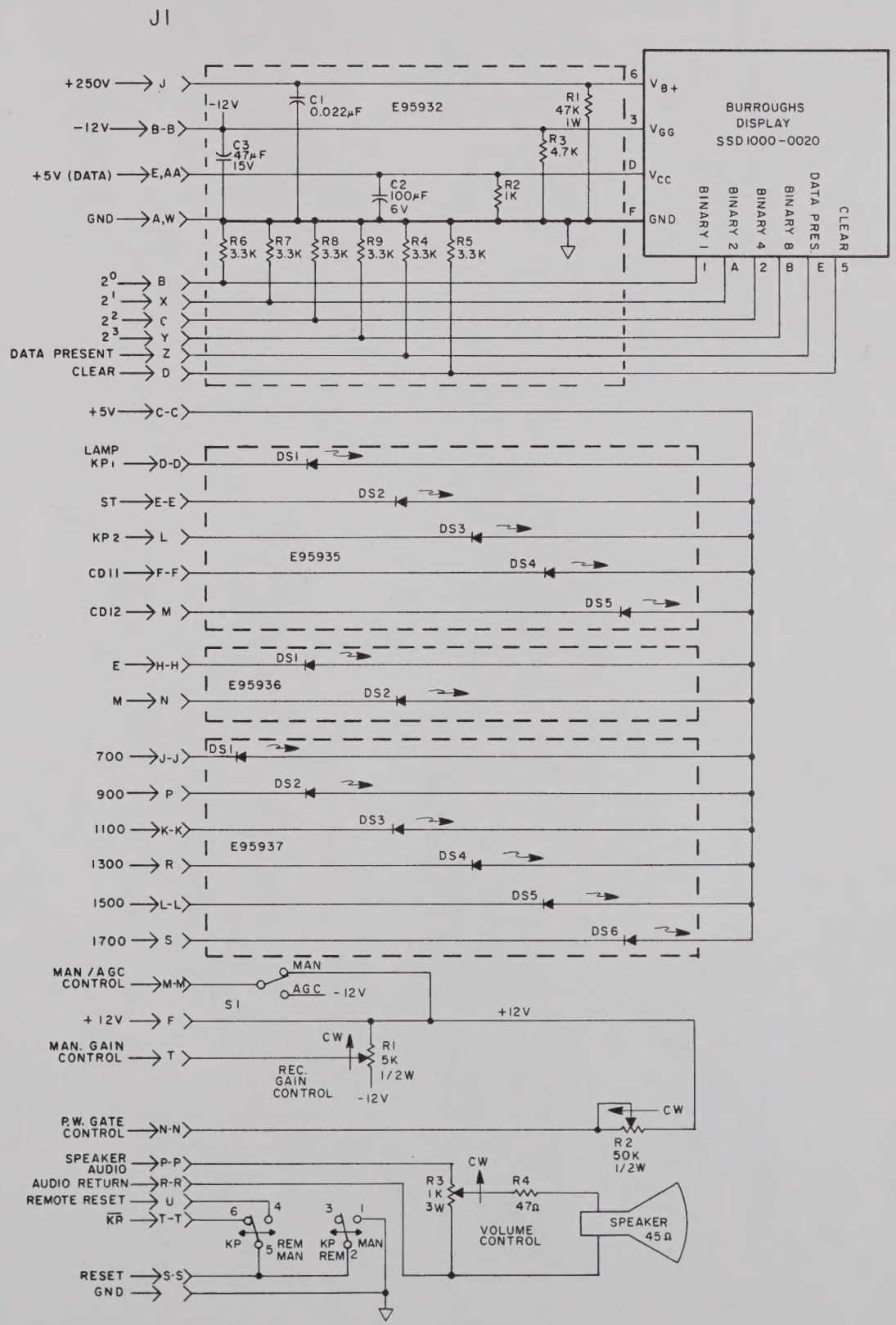


Figure 7-10. Schematic Diagram, Remote Display Unit

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